US Army Corps
of Engineers
Kansas City District

Engineering and Construction Division
Hydrologic Engineering Branch
Water Management Section

Annual Report of Reservoir Regulation Activities

Summary for 2003 - 2004

November 2004

NORTHWESTERN DIVISION, KANSAS CITY DISTRICT
SUMMARY OF LAKE REGULATION ACTIVITIES
AUGUST 1, 2003 TO JULY 31, 2004

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PURPOSE AND SCOPE.

This report summarizes the past year's regulation activities at storage projects within the boundaries of the Kansas City District (District) that are operated for flood control by the Water Management Section staff. It also summarizes major work items affecting the projects, and it outlines briefly the programs ongoing or proposed for the year ahead. Topics discussed in the report include climatology, project accomplishments, current project operations; major regulation problems and proposed solutions; lake regulation manuals; data collection programs and procedures; ongoing studies, and personnel of the Water Management Section. The reporting period for Water Management Section activities covers the operating year from August 1, 2003 through July 31, 2004, with additional discussion on proposed operations and studies programmed through calendar year 2005. Preparation of this report is in conformance with paragraph 13b of ER 1110-2-240, dated October 8, 1982.

LAKES IN THE KANSAS CITY DISTRICT.

The Kansas City District includes the watershed of the Missouri River from Rulo, Nebraska, (mile 498.1 above the mouth) to the junction of the Missouri and Mississippi Rivers near St. Louis, Missouri. During the period covered by this report, 29 storage projects, at which the Corps of Engineers (Corps) has either complete or partial water control responsibilities, were in operation within the District. The location of each lake and reservoir in the District is shown on Plate 1, and a summary of engineering data outlining the physical characteristics of each project is included as Plates 2A through 2E.

PROJECT FUNCTIONS AND GENERAL PLAN.

Functions served by storage facilities in the Kansas City District include: flood control, irrigation, water supply, low flow and navigation supplementation, water quality, hydropower, recreation, and fish and wildlife. Most functions except flood control are normally provided through the regulation of storage contained in the multipurpose pool. Releases from multipurpose storage are controlled by the manipulation of gates or other means in accordance with plans, schedules, and ratings prepared in advance to meet various conditions of inflow and demand. The general plan for regulation of flood control storage is to evacuate all accumulations in the flood control space as rapidly as downstream channel capacities and flow conditions permit. Should the top of the flood pool be exceeded, criteria have been developed for each project that schedule releases with an aim toward safeguarding the structure. Downstream interests are warned of the possibility of flooding should a surcharge operation appear likely. Although the storage space in the flood control pool is normally evacuated as quickly as downstream conditions allow, release schedules may be modified at times to serve beneficial purposes such as fish and wildlife enhancement.

CLIMATOLOGY AND HYDROLOGIC CONDITIONS.

The month of August 2003 was warm for much of the District. Much of the region continued with dry conditions and below normal precipitation. In Missouri, rains were plentiful, to the point of “too much too fast” in the west central and western reaches. Areas in and around Kansas City saw 6-8 inches, but farther north the totals fell off to basically nothing. These rains brought one- to two-category improvements for all of the state except for the northwest corner.

Kansas benefited from a parked cold front and Tropical Depression Grace's moisture plume. Copious rains (6-8"or more) pelted parts of Kansas. Flooding wasn't as bad as it could have been given the extremely parched soils in these parts, which acted like a sponge on otherwise torrential amounts.

September brought a transition into the autumn season across the District. Conditions were cool and dry for western Kansas and southern Nebraska. Conditions were cool and wet for Missouri and southern Iowa with 4-8" of rain.

October ended with the District having above normal temperatures and below normal precipitation. The long-term drought conditions continued to plague the region. There was an area of expansion of severe drought (D2) and extreme drought (D3) in northwestern Kansas and southwestern Nebraska. This was attributed to low amounts of precipitation and reports of low stream flow. Moderate drought (D1) was expanded eastward covering most of the Kansas and Nebraska border, per local reports of no water flowing into Harlan County reservoir. During this time of year, inflows normally exceed outflows in the reservoir. Missouri and southeastern Kansas received 3-6" of rain for the month.

Temperatures in November were normal across the District. Most of the District remained dry. There was little overall change in the Plains' drought depiction, which continued to feature a broad swath of moderate to extreme drought (D1 to D3) in northwestern Missouri and northwestern Kansas. The exception to the drought was in northern Missouri and southern Iowa where 4-7" of rain fell.

December overall was a mild month. Precipitation totals were generally less than 1.0 inch. Mountain snow pack remained good, and in most locations was at or above normal for this time of year. Moderate (D1) to Extreme (D3) drought expanded across southwestern Kansas, central Nebraska, and eastern Colorado. Monthly rainfall totals were 4-6" in southeastern Kansas, southwestern Missouri, and central Missouri.

January was a month of near normal temperatures. Much of the region was below normal for precipitation amounts. Eastern Nebraska and Kansas as well as central Colorado and southern Missouri were areas that did receive above normal precipitation amounts with some areas receiving 200% to 300% of normal for the month. Snow pack numbers are good, but not much above where they should be for this time of year.

February was typical for the District. Temperatures averaged well below normal with some of the coldest air of the season entrenching the region. Above normal snow fell across central and northeastern Kansas and southern Iowa, where the Abnormally Dry (D0) was pulled back across central Iowa where the heaviest precipitation occurred.

March was a very mild month. The drought conditions that plagued the region the last several years continued to hold on, especially with the below normal snow pack in the Rocky Mountains. However, above normal precipitation fell over much of the District with the exception of extreme western Kansas and eastern Colorado. The area of long-term, hydrological drought centered on northwestern Missouri also received substantial precipitation (1 to 2 inches), resulting in a reduction from severe to moderate drought (D2 to D1). However, there were still serious groundwater shortages and long-term precipitation deficits.

April was above average temperature-wise over most of the District. The mountain snow pack began melting out about a month early and much slower than normal, producing a runoff to

the upper Missouri River basin that was much less than forecast and well below normal. Most of the District felt below normal precipitation with significant rains remaining south in Oklahoma and the Ozarks of Missouri.

May was warm and dry with the northern half of Missouri receiving above normal rainfall. Severe to Extreme drought (D2 to D3) persisted from western Kansas and into eastern Colorado. Dodge City, Kansas set a record with a mere 0.25 inches for the entire month of May, beating the previous record of 0.40 inches set way back in 1886.

June was cool and wet. Temperatures across the region averaged well below normal. Much of the heaviest rains fell in eastern Colorado and Kansas, where several locations received over 9.00" of rain for the month. Much of the rain in the Kansas and Nebraska regions were associated with strong convective complexes that brought with them both heavy rain and severe weather.

Almost the entire region was below normal for average temperatures in July. Some locations in Kansas were close to 8 degrees F below normal for the month. The District saw good portions of the region receiving ample precipitation. Kansas was the state that showed the most rain during July with some locations measuring over 9.00" of rain for the month. Much of central and eastern Kansas had several strong rain events during July that pushed totals over 5.00" for the month in many locations.

PROJECT ACCOMPLISHMENTS.

Operating purposes at storage projects in the Kansas City District include flood control, irrigation, water supply, low flow and navigation supplementation, water quality, hydropower, recreation, and fish and wildlife. Project accomplishments in each of these functional areas, for the period covered by this report, are described briefly in the following subparagraphs.

Flood Control.

Stream flow regulation by storage projects in the Kansas City District began with the closure of Kanopolis Lake in February 1948. By July of that year, Kanopolis also provided the first flood control storage, benefiting downstream damage centers. Since this initial impoundment, stream flow regulation by District projects has produced flood reduction benefits estimated in the millions of dollars annually. In addition to the Corps of Engineers lake projects, local protection projects in the form of levees, floodwalls, and channel improvements also have provided flood reduction benefits amounting to millions of dollars. Federal and private agricultural levees along with temporary storage of flood flows in the main stem reservoir system

Table 1: Flood Reduction Benefits
(Thousand Dollars)

Project	Fiscal Year 2004	Cumulative
Clinton Lake, KS	$73	$813,183
Harlan County Lake, NE	$5	$150,090
Harry S Truman Resv., MO	$384	$1,840,619
Hillsdale Lake, KS	$208	$31,423
Kanopolis Lake, KS	$51	$1,159,779
Little Blue River Lakes, MO	$0	$50,813
Long Branch Lake, MO	$14	$48,170
Melvern Lake, KS	$8,051	$157,434
Milford Lake, KS	$84	$940,130
Perry Lake, KS	$94	$4,164,672
Pomme De Terre Lake, MO	$34	$66,109
Pomona Lake, KS	$4,766	$157,568
Rathbun Lake, IA	$452	$145,133
Smithville Lake, MO	$3,501	$521,439
Stockton Lake, MO	$62	$201,174
Tuttle Creek Lake, KS	$2,213	$3,951,226
Wilson Lake, KS	$213	$1,373,635
TOTALS	**$20,205**	**$15,772,597**

above Sioux City provide additional benefits within the District. Flood reduction benefits during Fiscal Year 2004 credited to all Corps lake projects in the District were $20,205,000. During the same period, benefits credited to Section 7 Bureau of Reclamation projects within the District totaled $307,000.

Irrigation.

Irrigation data from the Bureau of Reclamation (Reclamation) is currently available only for the 2003 calendar year. Reclamation project reservoirs had below average carryover storage from the 2002 water year with the exception of Keith Sebelius Lake and Cedar Bluff Reservoir. Of the 12 project reservoirs in the Kansas River Basin, only Keith Sebelius and Waconda Lakes, and Lovewell Reservoir did not record below average inflows during all 12 months of 2003. Keith Sebelius and Waconda Lakes recorded below average inflows during 11 months of 2003. Just prior to the irrigation season, Enders, Kirwin, Webster Reservoirs, along with Keith Sebelius, Swanson, Hugh Butler, Harry Strunk and Harlan County Lakes, did not have sufficient storage to provide water users with a full water supply. Only Lovewell Reservoir had some flood storage occupied prior to the irrigation season. The high irrigation demand months of July and August significantly reduced storage in those project reservoirs that had storage available for irrigation. Precipitation during July and early August was of little help in reducing the demands on project reservoirs. Storage in the Reclamation project reservoirs was below normal at the end of the 2003 irrigation season with the exception of Cedar Bluff Reservoir. The eleven Reclamation reservoirs in the Kansas River basin, plus the Corps' Harlan County Lake, provided 330,955 acre-feet of irrigation water to 197,929 acres of project lands during calendar year 2003, the latest period for which final values are available.

Comment [g1]: The 2004 figures will be available in January, before this report has to be submitted to RCC. Suggest discussing the consensus agreement at Harlan County, the results of the annual computations, and the effect on the pool. You provide volumes and acreages for previous years. Would be useful to have a comparison to previous years and/or averages to understand the significance. A table for each of the projects or at least Harlan County, would be useful.

The State of Colorado makes Bonny Reservoir storage water available to Hale Ditch and other natural flow appropriators under short-term water service contracts. Most of the 700 acres served by Hale Ditch are now owned and operated by the Division of Wildlife. During 2003, the Colorado Water Commissioner did not direct reservoir inflows from the South Fork of the Republican River and Landsman Creek passed through Bonny Reservoir into Hale Ditch. Likewise, the Colorado Department of Natural Resources did not request storage releases for irrigation purposes into Hale Ditch.

Municipal, Industrial Water Supply and Water Quality Control.

Three municipalities and one rural water district have executed water service contracts for full or supplemental water supplies from three Reclamation reservoirs. A contract with the city of Norton, Kansas, provides for a maximum annual usage of 1,600 acre-feet from Keith Sebelius Lake (Norton Dam). A contract with Beloit, Kansas, provides for a maximum annual usage of 2,000 acre-feet from Waconda Lake. Waconda Lake also provides up to 1,009 acre-feet of water for a contract with the Mitchell County Rural Water District No. 2. A contract with the City of Russell, Kansas, provides for a maximum annual usage of 2,000 acre-feet from Cedar Bluff Reservoir.

During calendar year 2003, the City of Norton used 590 acre-feet of storage from Keith Sebelius Lake for municipal purposes. Storage releases made from Waconda Lake for the city of Beloit totaled 572 AF, with an additional 10,110 AF bypassed for quality control as directed by the State Water Commissioner. Releases of 740 acre-feet were made to the Mitchell County

Rural Water District No. 2 from Waconda Lake. Water was not released from Cedar Bluff Reservoir during 2003 for the City of Russell. The State of Kansas used the fish hatchery facility located below Cedar Bluff Dam for waterfowl habitat. Only 12 AF was released to the facility.

Water supply contracts for lake storage space, annual withdrawals, or surplus water exist between the Corps of Engineers and the State of Kansas and 12 other municipalities and rural water districts within Kansas, Missouri, and Iowa. The State of Kansas in turn contracts with a large number of municipalities and industrial sites to supply water from the State's contracted storage space through the water assurance and water marketing programs. To date, assurance districts have been formed for users in the lower Smoky Hill River Basin, lower Kansas River and the State of Kansas portion of the Marais des Cygnes River. Water is supplied within the limits of each contract through designated lake releases or from intakes located on the lake at the following projects: Kanopolis, Milford, Tuttle Creek, Perry, Clinton, Melvern, Pomona, Hillsdale, Smithville, Longview, Rathbun, Long Branch, Stockton, and Harry S Truman.

Recommendations for minimum stream flows to benefit stream sanitation and for the maintenance of desirable water quality standards were originally established by the U.S. Public Health Service for many river reaches below proposed dams in the District. These recommendations were then utilized to establish minimum release requirements for many of the District lake projects. The minimum release standards set by the Corps water control plans are usually less than the minimum desirable stream flows set by state water authorities. The latter are intended to satisfy water right holders and fish and wildlife flow standards. In some cases, specific water quality storage allocations were included in the project planning to increase the reliability of the minimum flow releases. Depending on the project, the minimum release quantities may be constant through the year, or they may vary seasonally or vary depending on the amount of current lake storage. Minimum releases for the purposes of downstream quality control and stream sanitation range from 3 c.f.s. during the winter months at Hillsdale Lake to 100 c.f.s. at Tuttle Creek Lake. Seepage is generally considered sufficient to meet minimum flow requirements downstream of the Reclamation dams. Additional releases are made from Tuttle Creek, Milford, and Perry Lakes for water quality and water supply purposes during periods of low flow on the Kansas River. Releases from any lake may be reduced below minimum requirements for brief periods due to construction, periodic inspections, or emergencies.

Navigation.

Releases from the Missouri River main stem reservoir system are designed to provide equitable service to navigation and other project purposes, while at the same time recognizing the important flood control functions of the system. Navigation on the Missouri is limited to the ice-free season, with a full season normally extending from April 1 to December 1 at the mouth. Operating experience plus numerous studies have indicated that flows of 35,000 cfs at Kansas City are the minimum that will permit navigation. Groundings can occur with flows of that magnitude, and dredging may be needed to alleviate local problems. Therefore, an additional flow of 6,000 cfs above the minimum service target has been set as the "full service" level for the navigation function. Thus, a full-service target flow of 41,000 cfs at Kansas City is considered adequate to maintain the designed 9-foot by 300-foot channel with little or no dredging. Milford, Tuttle Creek and Perry lakes are at times called upon to supplement Missouri River flows below

Kansas City in order to meet the navigation requirement and to conserve water in the main stem lakes.

On April 21, 2004 the Reservoir Control Center notified the Kansas City District that navigation support would be required. A Desoto target of 2,500 cfs was established beginning April 29, 2004. This 2,500 cfs target was not continuous through out the entire season but was called for as needed on three separate supplementation periods. Tuttle Creek releases were increased to a maximum of 2,000 cfs to supplement Missouri River flows during the season but the lake did not drop below its multipurpose elevation. This was possibly due to the shortened navigation season and/or because of the agreement between the State of Kansas and the Corps of Engineers to store the lowest five percent of the flood pool in Milford, Tuttle Creek and Perry Lakes to be used for navigation support. Milford did not provide any support during this navigation season. Perry Lake releases were increased to a maximum of 500 cfs during this season. The navigation supplementation was taken primarily from Tuttle Creek this year. Perry Lake was used only for short periods until increases from Tuttle Creek reached Desoto. On October 8, 2004, the supplemental releases were stopped as the navigation season ended at the Kansas City reach on October 11, 2004.

Hydropower.

Hydropower is generated at two Kansas City District projects. Stockton Dam has one unit with a nameplate rated capacity of 45 megawatts, and an overload generation rate of 52 megawatts. Harry S Truman Dam has six units with a total nameplate rated capacity of 160 megawatts, and an overload generation rate of 180 megawatts. The Southwestern Power Administration markets power from Stockton and Harry S Truman.

Stockton's power operation continues to be restricted by downstream channel capacities that limit tailwater elevations to 777.0 feet, mean sea level and Highway "J" stages to a maximum reading of 17.5 feet. Generation by the Stockton plant during this report period totaled 37,780 megawatt hours.

Generation by the Harry S Truman plant totaled 258,616 megawatt hours during the period of this report. Power generation releases at Harry S Truman are restricted to four units during the week and three units on weekends between Memorial Day and Labor Day by the Consensus Plan. During the period December 1 to March 1, five units may be operated during the weekdays (total time limited to 600 hours per year) and three units on weekends. The tailwater elevation measured at the Highway 7 bridge at Warsaw is limited to 662.5 feet, Union Electric datum, during five-unit releases from the power pool. Flood control releases are made through the generation units as much as possible. When Truman pool level is above 710.0 feet, a minimum of one unit is operated continuously. The Consensus Plan for Truman was negotiated and approved between the Corps, the State, and the Southwestern Power Administration, and became effective March 1990.

Fish and Wildlife.

Water level management plans, which include the fluctuation of pool levels at various times of the year for the enhancement of fish and migrating waterfowl, were in effect during the report period at the following Kansas City District lakes: Smithville, Clinton, Hillsdale, Kanopolis, Melvern, Wilson, Pomme de Terre, Perry, Pomona, Milford, Rathbun, Tuttle Creek, Stockton, and Long Branch. Truman Lake makes releases for the downstream spring fish spawn

when water is available, in accordance with an agreement with Southwest Power Administration and the State of Missouri.

Recreation.

Recreational use of the Corps lakes is a highly visible and important function. Recreational use is enhanced when the lakes are operated close to their normal or multipurpose pool levels. During flood years when large quantities of water are stored in the flood pools and during drought years when the lake levels drop, then access to the lakes and the shoreline facilities, as well as the quality of the experience, is reduced. Park managers at the projects are also concerned about related factors such as facility maintenance and water quality. The fish and wildlife function is closely related to the recreation experience, and coordination with state and county park officials for park management is important. A list by projects of the visitation totals at Corps lakes is shown in Table 2. Project park facilities at Blue Springs, Hillsdale, Long Branch, Longview, and Smithville are leased to county or state agencies.

Table 2: Visitation Hours
October 1, 2003 through September 30, 2004

Project	Visitation (Visitor Hours)
Clinton Lake, KS	10,419,411
Harlan County Lake, NE	7,154,591
Harry S Truman Resv., MO	11,011,258
Hillsdale Lake, KS	1,559,257
Kanopolis Lake, KS	1,487,795
Long Branch Lake, MO	1,380,067
Longview/Blue Springs MO	4,288,194
Melvern Lake, KS	5,540,221
Milford Lake, KS	5,408,420
Perry Lake, KS	3,524,189
Pomme de Terre Lake, MO	16,992,611
Pomona Lake, KS	4,458,984
Rathbun Lake, IA	6,387,589
Smithville Lake, MO	7,622,247
Stockton Lake, MO	6,673,231
Tuttle Creek Lake, KS	2,068,268
Wilson Lake, KS	2,181,134
TOTALS	**98,157,467**

PROJECT OPERATIONS.

Corps of Engineer Lakes - August 1, 2003 through July 31, 2004.

No significant lake regulation activities occurred during the report period. All of the District's 18 lakes stored water in their flood pools during the past reporting period except Harlan County Lake. None of the 17 lakes storing excess water stored a significant amount. The maximum encroachment into exclusive flood control space was 9.72 feet above multipurpose level at Harry S Truman on March 15, 2004. Harlan County Lake experienced a historic minimum pool on January 20, 2004 of 1926.34 ft.,m.s.l.

With the exception of special operations required under the Endangered Species Act, and navigation storage held in the flood pools of Tuttle Creek, Milford and Perry Lakes, Corps lakes within the Kansas City District were regulated in accordance with normal procedures during the period covered by this report. These two issues are discussed in more detail in the Major Regulation Problems and Proposed Solutions section below. Details regarding the regulation of all projects are included, along with pool elevation hydrographs, in Appendix A of this report.

Bureau of Reclamation Projects – August 1, 2003 through July 31, 2004.

Reservoir operations at the eleven Reclamation projects in the Kansas City District were carried out in accordance with normal regulation procedures during the period covered by this report. At the Reclamation projects, all operations are scheduled for optimum benefits of the authorized project functions. Monthly, or as often as runoff and weather conditions dictate,

Reclamation personnel evaluate the carryover storage and estimated inflow at each reservoir to determine whether excess water is anticipated. If excess inflow is apparent, controlled releases are made to maximize lake and downstream benefits, including flood control.

The regulation of flood control storage in Reclamation reservoirs in the Kansas River basin has been assigned to the Kansas City District Water Management Section. When project inflows are sufficient to produce an encroachment into the flood pool, coordination is immediate between the two Federal agencies, and decisions are made regarding the regulation desired. Water Management staff issues regulation orders to the Reclamation's Water Operations Group at the McCook Field Office in Nebraska. The McCook Field Office is responsible for issuing orders for both flood control and conservation releases to the Reservoir Superintendent. Details on operation of Reclamation's reservoirs, along with pool elevation hydrographs, are included in Appendix B of this report.

Lovewell Reservoir was the only Reclamation reservoir that utilized flood pool storage during the report period. A small flood release was required from Lovewell Reservoir to reduce pool levels during the first week of July. Bonny Lake fell to a record low pool elevation of 3656.11 on July 31, 2004.

Proposed Operations - August 2003 Through Calendar Year 2004.

Corps and Reclamation storage lakes in the District contained a total of 5,355,571 AF of storage on August 1, 2004. Of the total volume in storage, 599,081 AF (11 percent) were contained in the Reclamation lakes and 4,756,490AF (89 percent) were contained in the Corps projects.

Fifteen of the eighteen Corps lakes and none of the eleven Reclamation lakes in the District contained storage in their flood control pools on August 1, 2004. The occupied flood control storage amounted to 460,763AF. This volume compares to 116,056 AF of flood control storage space occupied on August 1, 2003.

MAJOR REGULATION PROBLEMS AND PROPOSED SOLUTIONS.

Navigation Support

The State of Kansas reached a one-year agreement to store water in the flood pools of Milford, Tuttle Creek and Perry Lakes for navigation support during the summer of 2004. Discussions between the State of Kansas and both the Kansas City District and Northwest Division resulted in the one-year plan. Water storage was permitted in the flood pools up to a level equivalent to 5% of the total flood pool storage in each of the lakes. The 5% flood control pool elevations for each lake are:

Perry Lake	893.7 ft., m.s.l.
Milford Lake	1146.7 ft., m.s.l.
Tuttle Creek Lake	1081.0 ft., m.s.l.

As a result of the agreement, all navigation support during the 2004 navigation period was provided from the flood storage pools of the lakes.

Endangered Species Act

Beginning in 1999, releases at Milford and Tuttle Creek Lakes have been affected each summer by special operations required by the Endangered Species Act (ESA). Two listed bird species, the Piping Plover and the Least Tern, were first reported nesting on sandbars in the Kansas River during the mid-1990's. These birds have also affected operations along the Missouri River upstream of Omaha since they were first listed under ESA in 1985. The Terns and Plovers nesting season typically lasts from May through August. During that period, the Corps monitors the bird nests and when possible restricts releases from upstream lakes to protect them to the extent practical from local uncontrolled runoff. The lakes can only control a portion of the basin runoff from spring and summer storms, and many times the runoff from storms closer to the nests are sufficient to destroy them. Since the major nesting areas to date have been in the Manhattan to Topeka reach of the river, these operations have mainly affected Milford and Tuttle Creek Lakes. As much as 17 percent of the flood pool at Tuttle Creek Lake has been occupied by storage attributed to ESA operations.

In accordance with a U.S. Fish and Wildlife Missouri River Biological Opinion, the District has developed a plan of operation to monitor the nesting areas and coordinate lake releases. Since the 2000 nesting season, the District has contracted each year with Dr. Roger Boyd of Baker University in Baldwin, KS, to monitor nesting activities. The District's Environmental Resources Section administered the contract and provided coordination with other agencies, including the U.S. Fish and Wildlife Service. The Water Management Section has acquired an airboat and trailer to conduct additional monitoring. During the 2004 season, a Water Management Hydrologic Engineer, and an Operations Division biologist, provided monitoring of bird activity and Kansas River conditions in addition to Dr. Boyd.

During the 2004 season, two pair of Piping Plovers (*Charadrinus melodus*) and 17 pairs of Interior Least Terns (*Sterna antillarum*) were determined to be nesting along the river. A total of three Piping Plover nests and 32 Interior Least Tern nests were located and tracked, including one at Jeffrey Energy Center. Twenty Interior Least Tern nests were destroyed by flooding, nine nests were abandoned, no nests were destroyed by predators and only three nests had eggs hatch and none of these fledged. There were two Piping Plover nests that hatched, one of which fledged three juveniles and one nesting attempt was destroyed by a raccoon. There were four high water events that impacted tern nests.

Lovewell Deviation Request

Continued drought conditions and depleted inflows into Harlan County Lake resulted in a record low pool elevation on January 20, 2004. In an effort to improve recreation conditions at Harlan County Lake, the Kansas City District and the Bureau of Reclamation prepared a joint deviation request to store two feet of additional water in Lovewell Reservoir. Lovewell and Harlan County are operated as a system to provide irrigation support for the Bostwick Irrigation districts. Additional water stored in Lovewell Reservoir would offset the lack of storage in Harlan County Lake and result in improved Harlan County Lake conditions. Documents were prepared in accordance with Draft Guidance provided by Division, showing that storage of two feet additional water in Lovewell would not severely affect flood control capabilities of the project and would result in substantial benefits to the region.

In early 2004, extremely dry conditions existed within the Lovewell Reservoir drainage basin. The dry conditions would result in a much-reduced runoff from any major precipitation

event. The rainfall that resulted in the 1951 flood was the design storm for Lovewell Reservoir. The design flood was prepared by increasing the runoff from the design storm due to dry conditions in the basin prior to the 1951 event. Conditions within the basin now are considered drier than that of 1951 event. If the 1951 rainfall had reoccurred, the resultant runoff could have been controlled without usage of the bottom two feet in the Lovewell Reservoir flood pool.

Northwestern Division partially approved the deviation on February 26, 2004 for Lovewell Reservoir. A full two feet encroachment into the bottom of the Lovewell flood pool was denied. However a deviation to store up to 1.6 feet was approved to supplement storage from Harlan County Lake for irrigation purposes.

WATER CONTROL MANUALS.

Manual Status.

This section serves to provide the information requested in paragraph 13c of ER 1110-2-240, dated October 8, 1982, regarding the status of water control manuals.

Water control plans prepared for specific projects and basins within the Kansas City District have been documented in appropriate manuals as directed by paragraph 6c of the above referenced ER. Paragraph 6c also directs that water control plans be revised as necessary to conform with changing requirements resulting from developments in the project area and downstream, improvements in technology, new legislation, or other relevant factors, provided such revisions comply with existing Federal regulations and established Corps of Engineers policy.

The water control manual for Pomme de Terre Lake was reviewed by the Division and returned for corrections and clarifications on March 18, 1997. The comments are being addressed and the document will be resubmitted to the Division. The water control manual for Wilson Lake was submitted to the Division for review on June 13, 1997. The schedule and status of manuals for all projects is shown on Table 3.

Table 3: Project Manual Status and Revision Schedule

Reservoir/Lake	Stream/River	Owner	Report Status	Submission Schedule
Nebraska				
Master Manual	Republican	CE	Updated final submitted to NWD for review July 28, 1977	
Harlan County	Republican	CE	Revision approved by NWD May 10, 2001	
Harry Strunk	Medicine Creek	BR	Approved by NWD July 12, 1974	
Enders	Frenchman Creek	BR	Approved by NWD March 26, 1973	
Swanson	Republican	BR	Flood Control Regulation approved by HQUSACE October 6, 1969	
Hugh Butler	Red Willow Creek	BR	Flood Control Regulation approved by HQUSACE November 21, 1969	
Colorado				
Bonny	S. Fork Republican	BR	Approved by HQUSACE October 6, 1969	
Kansas				
Lovewell	White Rock Creek	BR	Approved by HQUSACE April 9, 1969 subject to comments	
Milford	Republican	CE	Approved December 1984. Minor revision approved Jan 1995	
Norton	Prairie Dog Creek	BR	Approved August 28, 1974	
Master Manual	Smoky Hill	CE	Approved March 28, 1975	
Kanopolis	Smoky Hill	CE	Revision submitted to NWD October 30, 1984	
Cedar Bluff	Smoky Hill	BR	Approved by NWD September 25, 1975	
Kirwin	N. Fork Solomon	BR	Approved by NWD February 6, 1974	
Webster	S. Fork Solomon	BR	Approved by NWD July 16, 1975	
Wilson	Saline	CE	Revision submitted to NWD June 13, 1997	
Waconda	Solomon River	BR	Approved by NWD July 12, 1972	
Master Manual	Kansas	CE	Approved by HQUSACE March 22, 1967 subject to comments	
Tuttle Creek	Big Blue	CE	Approved April 16, 1974. Minor revision approved January 1995	
Perry	Delaware	CE	Approved July 1973. Minor revision approved January 1995	
Clinton	Wakarusa	CE	Approved February 12, 1980	
Master Manual	Osage River	CE	Approved by HQUSACE Sep 21, 70 subject to comments	
Pomona	110 Mile Creek	CE	Approved February 1973	
Melvern	Marais Des Cygnes	CE	Approved June 27, 1985	
Hillsdale	Big Bull Creek	CE	Approved June 19, 1985	Sept 05
Missouri				
Pomme De Terre	Pomme De Terre	CE	Revision submitted to NWD September 1996, comments being addressed	Sept 05
Harry S Truman	Osage	CE	Interim manual approved by NWD May 12, 1981. Minor revision approved April 1996	
Stockton	Sac	CE	Approved August 21, 1975	
Smithville	Little Platte	CE	Approved August 12, 1979	
Long Branch	E. Fk Ltl. Chariton	CE	Interim manual approved November 21, 1978	
Longview	Little Blue	CE	Approved February 15, 1994	
Blue Springs	E. Fork Little Blue	CE	Approved January 27, 1994 with minor revisions submitted December 1994	
Iowa				
Rathbun	Chariton	CE	Approved October 19, 1981	

Other Reports.

Plates 2A-E list project data showing the date impoundment of storage began, the date the multipurpose pool (the active conservation pool in USBR projects) first filled, and the current status of Standing Instructions for Regulation of Storage in Corps of Engineers Lakes.

As indicated in Engineering Manual 1110-2-3600, it is essential that project operators (dam tenders, operations managers, power plant superintendents) at the various flood control and multiple-purpose reservoirs be supplied with regulation schedules to be followed in case of communication failure. These regulation schedules should be followed in case of communication failure with the headquarters from which instructions are normally issued during

flood situations. Standing Instructions have not yet been issued for Harry S Truman Reservoir, Clinton, Hillsdale, Long Branch, Smithville, Longview, and Blue Springs Lakes.

HYDROLOGIC DATA COLLECTION.

The primary objectives of Kansas City District's hydrologic data program is to provide information on precipitation and stream flow characteristics occurring over and within a particular area for a given period of time. These data are used for many purposes, including the design, construction, and maintenance of a wide variety of structures in and along streams; the management of lake releases during floods; the production of hydropower; the design and maintenance of navigation facilities; the control of pollution; the management of flood plains; the development of recreational facilities; the design of highway bridges and culverts; the establishing and administering of water rights and compacts; and the resolving of political, social, and legal water problems. As with any program, however, the restraint on funds and manpower, and the usefulness of the data obtained will determine to what extent the program will, or should, be pursued at any particular point in time. The overall program of observing, monitoring, and collecting hydrologic and meteorological data in the District is quite extensive yet flexible to meet operational and economic needs. Brief descriptions of the various types of data collection now being utilized are presented in the following paragraphs.

Collection and Processing of Water Control Data.

Hydrologic data such as precipitation, stream flow, and lake information are collected in the Kansas City District by: individual observers, Corps project offices, the National Weather Service, the Geological Survey, the Bureau of Reclamation, and certain state agencies. Several different methods of communication are used in the Kansas City District to receive these data including: electronic transfer, telephone, and fax. The electronic transfer of data includes FTP between agency computers and data transmitted through a satellite downlink and a Local Readout Ground Station (LRGS). Data received by the District is entered onto the Water Management Section's Unix server database by both automated and manual methods, depending on the data source. Software developed by Water Management Section staff provides a means to view, screen, and process the data for graphical and reporting purposes. The data is then uploaded to the MSC database in Omaha. Daily data and project reports are also available to the public at the Section's web site, http://www.nwk.usace.army.mil/current.html

The Water Management Section has acquired a second server and upgraded the existing server to serve as a backup for the MSC database in Omaha.

Automatic Remote Sensors.

Data Collection Platforms (DCP's) are the primary means by which Kansas City District obtains remote sensing data on stream stages and lake elevations. The DCP is a sophisticated device that collects the information from a USGS manometer and transmits the data to a GOES satellite for subsequent retrieval by the National Environmental Satellite, Data, and Information Service (NESDIS) at Wallops Island, Virginia. NESDIS then rebroadcasts all data over a single high-speed channel on a Domestic Communications Satellite (DOMSAT). The Water Management Section receives DCP data from NESDIS or directly from the DCP's with a DOMSAT receive station. Maintenance of the DCP's is performed by the USGS under contract with the Corps of Engineers. In 2004, the District supported 126 permanent DCP's. A

breakdown of the total number of DCP's, by states, shows 54 units in Missouri, 53 in Kansas, 11 in Nebraska, and 8 in Iowa.

Cooperative Hydrologic Programs.

Constraints on funds and manpower do not allow the Corps to administer an independent data collection program that satisfies all of its needs. Therefore, assistance is sought from other cooperating agencies. A nationwide program of data collection at selected stream gauging stations has been administered for a number of years by the U.S. Geological Survey (USGS). A similar network of reporting stations has been operated by the National Weather Service (NWS) for their river forecasting services. Arrangements have also been made with the USGS through which they supplement their network of reporting stations, or increase the frequency of reports, to better satisfy Corps needs. The program, designated the "Cooperative Hydrologic Reporting Network," is administered by the USGS and supported by funds transferred from the Corps and by National Streamflow Information Program (NSIP) funds. Arrangements for the services provided are made with USGS data chiefs in each state and submitted annually to the Chief of Engineers, through the Division Commander, for review and approval. A summary of funds expended for data collection purposes during the report period is included in the Personnel and Funding section at the end of this report.

Water Quality Investigations and Monitoring Activities.

The Water Quality Unit's (PM-PR-W) 2004 activities were highlighted by the continuation of long-term studies of the Big Bull (Hillsdale Lake), Chariton (Rathbun Lake), and Little Platte (Smithville Lake) watersheds. The Big Bull watershed studies with EPA 319 funding involve numerous federal, state, county, and local agencies, as well as citizen groups, in quantifying the levels of nutrients and herbicides throughout the watershed and implementing pollution reduction strategies. The latter include increased use of best management practices on agricultural lands and the use of constructed wetlands to improve the quality of point-source effluents. PM-PR-W teamed with Hillsdale Lake project personnel to perform the lake-monitoring portion of the work, which included monthly insitu profiling of temperature, dissolved oxygen, conductivity, pH, and redox; secchi measurements; sample collection and filtration; chlorophyll, turbidity, immunoassay herbicide, and suspended solids analyses; coordination with other laboratories; and data management.

In the eighth year of the multi-agency, cooperative study of the Chariton watershed, PM-PR-W and Rathbun Lake project personnel teamed to perform monthly surveys of four lake stations and the outlet. Sampling of 15 tributaries was carried out by Iowa State University Limnology Laboratory personnel. PM-PR-W performed chlorophyll, turbidity, suspended solids, and immunoassay herbicide analyses while the Environmental Research and Development Laboratory (ERD) performed nitrogen and phosphorous group, and QAQC pesticide analyses. PM-PR-W continued to provide data management for the long-term study. As in the Big Bull watershed studies, the Natural Resources Conservation Service (NRCS) with major support from 319 funding assisted in obtaining the voluntary support of the agricultural community in reducing the amount of non-point source runoff.

For its part in the Little Platte watershed studies, PM-PR-W teamed with Smithville Lake project personnel to perform monthly surveys of the three lake stations, the outlet, and the major tributary in 2004. Physical, chemical, and biological analyses noted above were performed by

PM-PR-W and ERD. Reports were provided to various members of the study and to the general public.

In addition the following lake projects supported the District water quality monitoring effort in 2004: Long Branch, Clinton, Perry, Milford, Tuttle Creek, Wilson, Kanopolis, Pomona, Melvern, Longview, Blue Springs, Pomme De Terre, Truman, and Harlan County. Approximately 200 samples per month during April-September were collected by project personnel at lake, outlet, and inflow stations and analyzed by PM-PR-W and ERD for herbicides and nutrients, respectively. Also PM-PR-W provided equipment, training, and technical support to the cooperating projects. Reports were provided to each of the participating projects and placed on the Internet for access by other agencies and the public.

Other activities to support the sampling and analytical capabilities of PM-PR-W were data management, procurement of supplies and equipment, maintenance and calibration of field and laboratory equipment, and maintenance of mobile laboratory and marine equipment. The unit also carried out a quality assurance/quality control (QA/QC) program with the cooperating laboratories.

Sediment Observations.

The Kansas City District Hydrology and Hydraulics Section (EC-HH) survey crew surveyed cross sections at stream channel degradation ranges downstream of Longview Lake Dam as part of a regular cycle of monitoring. At Longview Lake the ranges were last surveyed in 1985 and 1999. For this iteration, 6 of the 6 ranges were relocated, surveyed, and compared to the previous surveys. Range C-1 showed very little change in comparison to past surveys. Range C-2 showed a more significant change of 3-5 feet of degradation on each side of the channel bottom. The remaining four ranges show some change of erosion and silt since last surveyed.

In April the EC-HH survey crew surveyed cross sections at stream channel degradation ranges downstream of Smithville Lake Dam as part of a regular cycle of monitoring. At Smithville Lake the degradation ranges were last surveyed in 1978, 1989, and 1999. For this iteration, 7 of the 7 ranges were relocated, surveyed, and compared to the previous surveys.

The EC-HH survey crew surveyed cross sections at stream channel degradation ranges downstream of Longbranch Lake Dam as part of a regular cycle of monitoring. The degradation ranges were last surveyed in 1979, 1988, and 1998. For this iteration, 7 of the 9 ranges were relocated, surveyed, and compared to the previous surveys. Ranges 1C and 2C showed very little change with less than 1 foot of degradation. Ranges 3C and 4C were not found and assumed to be destroyed due to the construction of new bridges at each of the sites. The remaining five sites had little change compared to past surveys.

The EC-HH survey crew surveyed cross sections at stream channel degradation ranges downstream of Wilson Lake Dam as part of a regular cycle of monitoring. These Ranges were last surveyed in 1961, 1984, and 1998. For this iteration, 4 of the 16 ranges were relocated and resurveyed by the crew. These ranges were compared to previous surveys within EC-HH. Ranges 1 and 2 show little change from the latest survey having less than 1 foot of degradation within the channel. Range 3 on the other hand, shows to have significant degradation of 2-5 feet with some erosion as well. Range 4 looks to have silted in 1-2 feet.

Through an interagency cooperative agreement with the USGS, the District collects point, depth integrated, and bed sample sediment samples at three Missouri River stations and two inflow stations to Harry S. Truman Reservoir. The Missouri River data at St. Joseph, Kansas City, and Hermann include point velocities. Laboratory analyses are performed at the USGS facility at Rolla, Missouri, and the results are stored in their database. The USGS publishes the suspended sediment load data for the Schell City and Clinton stations.

RESEARCH AND STUDIES.

During the report period, the section pursued the development of an operation model for the Kansas River Basin (Model). The Model uses Version 4.4.4 of the RiverWare lake operation program developed by the Center for Advanced Decision Support for Water and Environmental Systems in Boulder, Colorado (CADSWES). The Model should operate in future versions of RiverWare, provided that CADSWES maintains backward compatibility. The working model was completed and incorporates phase flood control operation based on downstream control points, surcharge operation, water quality minimum flows and seasonal pool variation. Data development has not yet been completed. The model operates through a Solaris operating system in a UNIX environment.

Determination of historic flow values for use in the model has been pursued through a parallel work effort. The assistance of recently hired Hydrology & Hydraulics Section (H&H) personnel was acquired to facilitate model completion,. H&H was tasked with developing historic lake inflow values, and historic gage flow amounts for all control points within the basins. The historic period is January 1, 1929 through December 31, 2001. Development of the needed flow values is ongoing.

The Kansas River Model has been developed as a base conditions model. Modifications will be made to the lake operation methods to simulate different lake operation methods due to changed conditions and the contemporary needs of the basin. The baseline condition and alternatives will be formulated and compared to determine the effects of change on the lakes and downstream flows. The Model does not precisely represent the actual conditions in the basin for the period of the study. Rather the Model provides a baseline that can be used to evaluate the hydrologic changes that would occur, due to a change in the operation methodology of the lakes. Evaluation will consist of a comparison between the baseline model and the model of any alternative operation procedure. The difference in the hydrologic results can be used to estimate the level of change that would ensue from the different operation.

TRAINING AND METHODS.

Table 4: Staff Training

Employee	Course or Training
Michael Gossenauer	New Employee Orientation
Steve Spaulding	Watershed Management Workshop

Training of Water Management Section staff progresses as time and scheduling permit. Technical abilities are enhanced as individuals continue to pursue courses on their own initiative. During the period of this report, Section employees participated in the training courses listed in Table 4. In addition, all staff members attended in-house training on Project Management Business Processes, and Prevention of Sexual Harassment Training.

PERSONNEL AND FUNDING

Personnel

Authorized positions of the Water Management Section at the close of the fiscal year (September 30, 2004) consisted of one Supervisory Hydraulic Engineer, three Hydraulic Engineers, one Hydrologist, one Student Trainee, one Civil Engineer Intern, and three Hydrologic Technicians. Alan Bruns, Hydrologist, was temporarily assigned to work in Iraq from June 1, 2003 until the end of November 2003. At the end of this reporting period, the Section had two vacant positions. A listing of personnel in the Section at the end of the report period by name and title is shown in Table 5.

Table 5: Water Management Section Personnel

Employee	Grade
Christopher Purzer (1)	GS-13
Alan Bruns (3)	GS-12
Jan Doughman (4)	GS-11
Michael Gossenauer (6)	GS-09
Jerry Holtz (4)	GS-11
Vacant (2)	
Andy Meyerkord (5)	GS-07
Debbie Noble (4)	GS-11
Edward Parker (2)	GS-12
Steve Spaulding (2)	GS-12
Vacant (2)	

Job Title
(1) Supervisory Hydraulic Engineer
(2) Hydraulic Engineer
(3) Hydrologist
(4) Hydrologic Technician
(5) Student Trainee (Civil Engineering)
(6) Civil Engineer Intern

Funding

Activities of the Water Management Section are funded from the following sources:

Planning

Part of the funds appropriated for survey reports, flood plain information studies, and project planning studies are assigned to the Water Management Section for special studies if water control plans or associated studies are included in connection with the planning and design of projects in the Kansas City District.

Operations and Maintenance

Operation of the existing lakes and reservoirs in the Kansas City District requires stream flow forecasting, water control planning, stream gauging, and other related activities for each authorized function at Corps of Engineers projects, and for the flood control function at Bureau of Reclamation projects. Operation and maintenance funds are used for these purposes.

Technical Services and Flood Emergency

Technical services provided to non-Federal interests, flood emergency operations, post flood reports, and the annual flood report are tasks assigned to the Water Management Section. These activities vary from year to year. Special accounts are provided for these services. Individuals in the Section may also receive special funding from other sources when they participate as a technical resource on Project Development Teams

Data Collection Programs

The Cooperative Stream Gauging Program with the four U.S. Geological Survey districts (Kansas, Nebraska, Iowa, and Missouri) includes 136 stations. Kansas City District funding for this program during FY 2005 is $1,252,120, a slight increase from the FY 2004 program.

Fiscal year expenses for data collected in FY 2003 and FY 2004, and the programmed expenses for FY 2005 are shown in Table 6 below.

Table 6: Data Collection Expenditures

Program	FY 2003	FY 2004	FY 2005
U.S.G.S	$1,251,360	$1,211,310	$1,252,120
Independent Stations	$0	$0	$0
TOTAL	$1,251,360	$1,211,310	$1,252,120

OMAHA DISTRICT

NEBRASKA

IOWA

ROCK ISLAND DISTRICT

CHICAGO DISTRICT

ILLINOIS

LOUISVILLE DISTRICT

ST. LOUIS DISTRICT

MISSOURI

COLO.

KANSAS

ALBUQUERQUE DISTRICT

OKLAHOMA

TEXAS

KANSAS CITY DISTRICT

KANSAS AAP - PARSONS

LITTLE ROCK DISTRICT

MEMPHIS DISTRICT

ARKANSAS

KY.

TENN.

DEFENSE MAPPING AGENCY

Lake McConaughy

Lake of the Ozarks

Lake Jacomo

Lake Carl Blackwell

Lake of the Cherokees

Lake Texoma

Lake Tanneycomo

Markham Ferry

Crab Orchard Lake

Little Grassy Lake

Devil's Kitchen Lake

Reelfoot Lake

SAYLORVILLE

CORALVILLE

RED ROCK

RATHBUN

MERCER

TRENTON

PATTONSBURG

BROOKFIELD

LONG BRANCH

BRAYMER

SMITHVILLE

FONDULAC DAM

FARMDALE DAM

SHELBYVILLE

MARK TWAIN

CARLYLE

REND LAKE

TUTTLE CREEK

MILFORD

PERRY

CLINTON

HILLSDALE

POMONA

MELVERN

HARRY S. TRUMAN

POMME DE TERRE

STOCKTON

CLEARWATER

WAPPAPELLO

BULL SHOALS

NORFORK

TABLE ROCK

BEAVER

BELL FOLEY

ENDERS

HUGH BUTLER

HARRY STRUNK

SWANSON

HARLAN COUNTY

KEITH SEBELIUS

BONNY

LOVEWELL

WACONDA

KIRWIN

WEBSTER

WILSON

CEDAR BLUFF

KANOPOLIS

COUNCIL GROVE

MARION

JOHN REDMOND

EL DORADO

TORONTO

FALL RIVER

CHENEY

DOUGLASS

ELK CITY

PEARSON-SKUBITZ

BIG HILL

HULAH

COPAN

GREAT SALT PLAINS

KAW

SHIDLER

SAND

BIRCH

CANDY

SKIATOOK

KEYSTONE

HEYBURN

OOLOGAH

FORT SUPPLY

CANTON

JOHN MARTIN

BLUE SPRINGS

LONGVIEW

FORT LEAVENWORTH

LAKE CITY AAP

SUNFLOWER AAP

FORT RILEY

WHITEMAN AFB

JEFFERSON CITY

TOPEKA

MCCONNELL AFB

TULSA

FORT SCOTT

FORT GIBSON

FORT LEONARD WOOD

VICINITY OF KANSAS CITY

MISSOURI

KANSAS

JOHNSON COUNTY

JACKSON COUNTY

CASS COUNTY

INDEPENDENCE

BLUE SPRINGS

LEE'S SUMMIT

GRANDVIEW

MERRIAM

SCALE IN MILES

LEGEND

LAKES

- COMPLETED
- UNDER CONSTRUCTION
- PLANNING
- AUTHORIZED
- RECOMMENDED
- BUREAU OF RECLAMATION PROJECTS *
- OTHERS OF NOTE

LOCAL PROTECTION

- COMPLETED OR UNDER CONSTRUCTION
- AUTHORIZED
- PLANNING

MILITARY BASE

BOUNDARIES

- KANSAS CITY DISTRICT (CIVIL)
- KANSAS CITY DISTRICT (MILITARY)
- KANSAS CITY DISTRICT (REGULATORY)
- OTHER DISTRICTS

SCALE IN MILES

DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT
CORPS OF ENGINEERS

FEBRUARY 1994
FILE NO. K-1-734

PLATE 1

SUBJECT	MELVERN LAKE	POMONA LAKE	HILLSDALE LAKE	STOCKTON LAKE	POMME DE TERRE LAKE	HARRY S. TRUMAN RESERVOIR
GENERAL						
Location of Dam	Near Melvern, KS	Near Pomona, KS	Near Paola, KS	Near Stockton, MO	Near Hermitage MO	Near Warsaw, MO
Stream / River	Marais des Cygnes River	110 Mile Creek	Big Bull Creek	Sac River	Pomme de Terre River	Osage River
Miles above Mouth	175.4	8.3	18.2	51.4	45.6	175.1
Contributing Drainage Area, square miles	349	322	144	1,160	611	8,914 (4)
Approximate Length of Full Reservoir, miles	22	12	15	24	28	122
Shoreline, miles (1)	101	52	51	298	113	958
Maximum Discharge of Record nr Dam Site	68,500 cfs (July 11, 1951)	38,600 cfs (July 11, 1951)	45,200 cfs (July 11, 1951)	120,000 cfs (May 19, 1943)	70,000 cfs (Aug 8, 1927)	259,000 cfs (May 17, 1943)
Date of Closure	October 2, 1970	July 19, 1962	June 15, 1980	September 23, 1968	June 28, 1960	July 21, 1977
Date Storage Began	August 1, 1972	October 18, 1963	September 19, 1981	December 12, 1969	October 29, 1961	February 7, 1979
Date Multipurpose Level Reached	April 4, 1975	June 5, 1965	February 23, 1985	December 18, 1971	June 15, 1963	November 29, 1979
Operating Agency	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers
DAM AND EMBANKMENT				911.0 for concrete section		
Top of Dam Elevation, feet msl	1,078.0	1,031.0	952.2	912.0 for embankment	906.0	756.0
Length of Dam, feet (net)	9,650	7,750	8,700 plus 3,300 dike	5,100 plus 5,600 dike	4,630 plus 2,790 dike	5,000 plus 7,500 dike
Damming Height, feet (2)	105	83	79	132	124	105
Type of Fill	Earth	Earth	Earth	Rock Shell	Earth	Earth
Fill Quantity, cubic yards	9,100,000	5,200,000	6,964,000	7,100,000	5,800,000	8,500,000
SPILLWAY						
Location	Left Abutment	Right Abutment	Right Abutment	Left Abutment	Right Abutment	Center of Dam
Crest Elevation, feet msl	1,057.0	1,006.0	935.0	861.5	874.0	692.3
Width, Feet	200	200	50	160	170	160
Number, Size, and Type of Gates	None	None	None	4 - 40'x30.5' Tainter	None	4 - 40'x47.3' Tainter
Discharge Capacity, Top of Surcharge Pool	36,000 cfs	50,300 cfs	4,750 cfs	182,500 cfs	73,000 cfs	284,000 cfs
RESERVOIR (3)						
Surcharge Pool Elevation and Area	1,073.0 ft msl 22,673 ac	1,025.4 ft msl 14,584 ac	948.0 ft msl 10,983 ac	906.2 ft msl 48,053 ac	900.2 ft msl 25,456 ac	751.1 ft msl 295,870 ac
Flood Control Pool Elevation and Area	1,057.0 ft msl 13,935 ac	1,003.0 ft msl 8,522 ac	931.0 ft msl 7,413 ac	892.0 ft msl 38,281 ac	874.0 ft msl 15,999 ac	739.6 ft msl 209,048 ac
Multipurpose Pool Elevation and Area	1,036.0 ft msl 6,912 ac	974.0 ft msl 3,865 ac	917.0 ft msl 4,575 ac	867.0 ft msl 24,632 ac	839.0 ft msl 7,790 ac	706.02 ft msl (5) 55,406 ac
Surcharge Storage, AF	1,073.0 - 1,057.0 289,410	1,025.4 - 1,003.0 255,327	948.0 - 931.0 155,799	906.2 - 892.0 608,708	900.2 - 874.0 535,724	751.1 - 739.6 2,910,768
Flood Control Storage, AF	1,057.0 - 1,036.0 208,207	1,003.0 - 974.0 176,123	931.0 - 917.0 83,570	892.0 - 867.0 776,066	874.0 - 839.0 406,821	739.6 - 706.02 4,005,392
Multipurpose Storage, AF	1,036.0 - 965.0 152,051	974.0 - 930.0 64,208	917.0 - 852.5 76,270	867.0 - 765.0 874,887	839.0 - 750.0 237,356	706.02 - 631.0 1,181,640
Gross Storage, AF	1,057.0 - 965.0 360,258	1,003.0 - 930.0 240,331	931.0 - 852.5 159,840	892.0 - 765.0 1,650,953	874.0 - 750.0 644,177	739.6 - 631.0 5,187,032
Design Sediment Reserve Storage	26,000 AF for 100 years	28,000 AF for 100 years	11,000 AF for 100 years	25,000 AF for 100 years	13,000 AF for 50 years	244,000 AF for 100 years
Measured Sediment Inflow	4,064 AF (1972 to 1985)	7,045 AF (1963 to 1989)	1,928 AF (1981 to 1993)	8,953 AF (1969 to 1987)	4,358 AF (1961 to 1974)	22,321 AF (1979 to 1992)
OUTLET WORKS						
Location	Right Abutment	Right Abutment	Left Abutment		Right Abutment	
River Outlet Type	Gated Horseshoe Conduit	Gated Horseshoe Conduit	Gated Oblong Conduit	None	Gated Tunnel	None
Number and Size of Conduit	1 - 11.5'	1 - 13.5'	1 - 15.92'x11.67'		1 - 14'	
Length of Conduit, feet	754	720.5	685		560	
Entrance Invert Elevation	962.0 ft msl	925.0 ft msl	868.0 ft msl		750.0 ft msl	
Discharge Capacity, Top of Surcharge Pool	6,700 cfs	9,200 cfs	8,200 cfs		12,750 cfs	
Discharge Cap, Top of Flood Control Pool	6,235 cfs	8,170 cfs	7,400 cfs		11,500 cfs	
Discharge Cap, Top of Multipurpose Pool	5,520 cfs	6,400 cfs	6,150 cfs		9,650 cfs	
Service Gates, Number and Size	2 - 6'x12'	2 - 6.5'x14'	2 - 5.33'x15.92'		2 - 6.5'x14'	
Emergency Gates, Number and Size	2 - 6'x12'	2 - 6.5'x14'	1 - 5.33'x15.92'		1 - 6.5'x14'	
Low Flow Gates, Number and Size	2 - 2'x2'	2 - 2'x2'	2 - 2'x2'	2 - 24" dia	1 - 24" Butterfly	
Provision for Power	None	None	None	3 - 20'x40'		12 - 17'x26.5'
POWER FACILITIES						
Generator Turbine Units, Number				1		6
Generator Name Plate Capacity, kw				45,200		160,000
Turbine Rating, hp				75,600 (56 ft head)		254,400
Turbine Type				Kaplan (Vertical Shaft)		Kaplan (Inclined Shaft)
Maximum (Full Pool) Head and Discharge				112 ft (6,300 cfs)		79.2 ft (31,800 cfs)
Avg (Power & MP Pool) Head, Discharge				85 ft (7,900 cfs)		42.5 ft (65,000 cfs)
Minimum Head and Discharge				62 ft (11,000 cfs)		41 ft (68,000 cfs)
Reversible Pump Turbines				None		6
Total Dynamic Head, feet						50
Discharge with 5 Units at Max Head, cfs						27,500
Maximum Power Required, hp						197,000
Maximum Drawdown, feet msl				845		704

REMARKS
(1) With pool at multipurpose level.
(2) Damming height is from the original riverbed to the top of the flood control pool.
(3) Based on latest available storage data. The revision dates of the current area - capacity tables are indicated below with the effective dates in parentheses:
Melvern, February 1986 (effective March 1, 1986)
Pomona, March 1990 (effective April 1, 1990)
Hillsdale, 1969 (initial)
Stockton, February 1988 (effective May 1, 1988)
Pomme de Terre, February 1985 (effective Mar 85)
Harry S. Truman, April 1993 (effective Mar 94)
(4) The total drainage area above Truman Dam is 11,500 square miles. The indicated total is the local drainage area below the upstream dams.
(5) In 1994, 1000 AF of flood control storage at Truman Reservoir was reallocated to water supply.
The top of the multipurpose pool was adjusted from 706.0 to 706.018
TOTALS
417,619 ac
293,198 ac
103,180 ac
4,755,736 AF
5,656,179 AF
2,586,412 AF
8,242,591 AF
ac = acres
AF = acre-feet
ft = feet
msl = elevation above mean sea level
cfs = cubic feet per second
kw = kilowatts
hp = horsepower

SUMMARY OF ENGINEERING DATA
OSAGE RIVER BASIN PROJECTS

U.S. Army Corps of Engineers
Kansas City District
December 2004

Plate 2A

SUBJECT	SMITHVILLE LAKE	LONGVIEW LAKE	BLUE SPRINGS LAKE	RATHBUN LAKE	LONG BRANCH LAKE	REMARKS
GENERAL						(1) With pool at multipurpose level.
Location of Dam	Near Smithville, MO	Kansas City, MO	Kansas City, MO	Near Rathbun, IA	Near Macon, MO	(2) Damming height is from original riverbed to top of flood pool.
Stream / River	Little Platte River	Little Blue River	East Fork Little Blue River	Chariton River	East Fork Little Chariton River	(3) Based on latest available storage data. The revision dates of the current area capacity tables are indicated below with the effective dates in parentheses:
Miles above Mouth	13.6	42.9	28.8	142.3	78	Smithville Lake, February 1990 (effective March 1, 1990)
Contributing Drainage Area, square miles	213	50.3	32.8	549	109	Longview Lake, May 1970 (initial)
Approximate Length of Full Reservoir, miles	18	3.5	2.5	14	9	Blue Springs Lake, September 1974 (initial)
Shoreline, miles (1)	175	24	12	155	24.2	Rathbun Lake, January 2000 (effective December 1, 2000)
Maximum Discharge of Record near Dam Site	76,600 cfs (July 20, 1965)	18,700 cfs (August 13, 1982)	11,000 cfs (August 13, 1982)	21,800 cfs (March 31, 1960)	30,000 cfs (April 21, 1973)	Long Branch Lake, January 1989 (effective July 1, 1989)
Date of Closure	July 13, 1976	June 16, 1983	August 12, 1986	September 29, 1967	September 3, 1976	(4) Spillway flood routing at Long Branch Lake revised for Emergency Action Plan, dated 1981.
Date Storage Began	October 19, 1979	September 16, 1985	September 27, 1988	November 21, 1969	August 2, 1978	(5) Flows above 1,800 cfs result in overtopping of the outlet stilling basin walls
Date Multipurpose Level Reached	June 11, 1982	September 23, 1986	March 18, 1990	October 10, 1970	May 19, 1981	
Operating Agency	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	
DAM AND EMBANKMENT						
Top of Dam Elevation, feet msl	895.0	926.6	840.0	946.0	826.0	
Length of Dam, feet (net)	4,000	1,900	2,500	10,600	3,550	
Damming Height, feet (2)	80.2	110	70	82	71	
Type of Fill	Rolled Earth	Earth	Earth and Rock	Rolled Earth	Rolled Earth	
Fill Quantity, cubic yards	3,200,000	2,500,000	1,200,000	4,700,000	1,855,000	
SPILLWAY						
Location	Right Abutment	Left Abutment	Left Abutment	Right Abutment	Right Abutment	
Crest Elevation, feet msl	880.2	911.3	823.6	926.0	809.0	
Width, feet	50	200	300	500	50	
Number, Size, and Type of Gates	None	None	None	None	None	
Discharge Capacity, Top of Surcharge Pool	4,800 cfs	22,970 cfs	37,800 cfs	45,600 cfs	9,860 cfs (4)	
RESERVOIR (3)						**TOTALS**
Surcharge Pool Elevation and Area	891.1 ft msl 14,611 ac	922.9 ft msl 3,207 ac	837.7 ft msl 1,200 ac	940.0 ft msl 31,135 ac	821.2 ft msl 6,608 ac (4)	56,761 ac
Flood Control Pool Elevation and Area	876.2 ft msl 9,990 ac	909.0 ft msl 1,964 ac	820.3 ft msl 982 ac	926.0 ft msl 22,452 ac	801.0 ft msl 3,663 ac	39,051 ac
Multipurpose Pool Elevation and Area	864.2 ft msl 7,115 ac	891.0 ft msl 927 ac	802.0 ft msl 722 ac	904.0 ft msl 10,329 ac	791.0 ft msl 2,429 ac	21,522 ac
Recreation Pool Elevation and Area		870.0 ft msl 432 ac				432 ac
Surcharge Storage	891.1 - 876.2 182,198 AF	922.9 - 909.0 35,370 AF	837.7 - 820.3 19,039 AF	940.0 - 926.0 368,859 AF	821.2 - 801.0 101,880 AF (4)	707,346 AF
Flood Control Storage	876.2 - 864.2 101,777 AF	909.0 - 891.0 24,810 AF	820.3 - 802.0 15,715 AF	926.0 - 904.0 349,173 AF	801.0 - 791.0 30,327 AF	521,802 AF
Multipurpose Storage	864.2 - 810.0 141,666 AF	891.0 - 870.0 13,579 AF	802.0 - 760.0 10,842 AF	904.0 - 857.0 221,360 AF	791.0 - 750.0 34,189 AF	421,636 AF
Recreation Storage		870.0 - 810.0 8,555 AF				8,555 AF
Gross Storage	876.2 - 810.0 243,443 AF	909.0 - 810.0 46,944 AF	820.3 - 760.0 26,557 AF	926.0 - 857.0 570,533 AF	801.0 - 750.0 64,516 AF	951,993 AF
Design Sediment Reserve Storage	52,300 AF for 100 years	2,000 AF for 100 years	300 AF for 100 years	24,000 AF for 100 years	4,000 AF for 100 years	
Measured Sediment Inflow	4,987 AF (1979 to 1993)	20 AF/year (estimated)	3 AF/year (estimated)	240 AF/year (estimated)	483 AF (1978 to 1988)	
OUTLET WORKS						
Location	Right Abutment	Left Abutment	Right Abutment	Right Abutment	Right Abutment	
River Outlet Type	Rectangular Conduit	Concrete Arch	Arch Conduit	Horseshoe Conduit	Concrete Arch	
Number and Size of Conduit	1 - 8'x9'	1 - 5.5'x5'	1 - 3.5'x4.75'	1 - 11'	1 - 6'x5.5'	
Length of Conduit, feet	696	916	485	539	450	
Entrance Invert Elevation	805.0 ft msl	816.0 ft msl	768.5 ft msl	855.0 ft msl	760.0 ft msl	
Drop Inlet Crest Elevation		891	802.0 ft msl			
Low Flow Gate Intake Elevation		875 - 861	791.5			
Discharge Cap, Top Flood Control Pool	3,150 cfs	1,200 cfs	570 cfs	5,160 cfs (5)	910 cfs	
Discharge Cap, Top of Multipurpose Pool	2,940 cfs	0 (except low flow outlets)	0 (except low flow outlets)	4,220 cfs (5)	495 cfs	
Service Gates, Number and Size	2 - 4.25'x9.25' Slide			2 - 6'x12' Slide	2 - 24" Slide	
Emergency Gates, Number and Size	2 - 4.25'x9.25' Slide	1 - 6'x7'	1-4.5'x5'	2 - 6'x12' Slide	1 - 6'x6'	
Low Flow Gates, Number, Size, Type		2 - 24" Knife Valves	1-2' Knife Valve			
Low Flow Gates, Number and Size	1 - 2'x2'	2 - 24" Knife Valves	1-2' Knife Valve	2 - 2' x2' Slide	1 - 18" Slide	
Provision for Power	None	None	None	None	None	
Provision for Water Supply	1 - 5.75' Pipe A portion of MP storage pumped from pool	None	None	No pipe outlets, water supply released to river	No pipe outlets, water supply pumped from pool.	

ac = acres
AF = acre-feet
ft = feet
msl = elevation above mean sea level
cfs = cubic feet per second

SUMMARY OF ENGINEERING DATA
LOWER MISSOURI RIVER BASIN PROJECTS

U.S. Army Corps of Engineers
Kansas City Distict
December 2004

Plate 2B

SUBJECT	MILFORD LAKE	TUTTLE CREEK LAKE	PERRY LAKE	CLINTON LAKE	REMARKS
GENERAL					
Location of Dam	Near Junction City, KS	Near Manhatten, KS	Near Perry, KS	Near Lawrence, KS	(1) With pool at multipurpose level.
Stream / River	Republican River	Big Blue River	Delaware River	Wakanusa River	(2) Damming height is from the original riverbed to the top of the flood control pool.
Miles above Mouth	7.7	10	5.3	22.2	(3) Based on latest available storage data. The revision dates of the current
Contributing Drainage Area, square miles	17,388 (4)	9,628	1,117	367	area - capacity tables are indicated below with the effective dates in parentheses:
Approximate Length of Full Reservoir, miles	30	50	20	17	Milford Lake, March 1982 (effective March 10, 1982)
Shoreline, miles (1)	163	112	160	82	Tuttle Creek Lake, October 2000 (effective February 1, 2001)
Maximum Discharge of Record near Dam Site	171,000 cfs (June 3, 1935)	98,000 cfs (June 1951)	94,600 cfs (June 1951)	24,200 cfs (July 1951)	Perry Lake, May 1990 (effective June 1, 1990)
Date of Closure	August 24, 1964	July 20, 1959	August 2, 1966	August 23, 1975	Clinton Lake, December 1991 (effective March 1, 1994)
Date Storage Began	January 16, 1967	March 7, 1962	January 15, 1969	November 30, 1977	(4) Total drainage area above Milford is 38,621 square miles. The indicated total is
Date Multipurpose Level Reached	July 14, 1967	April 29, 1963	June 3, 1970	April 3, 1980	the local drainage area below Harlan County Dam.
Operating Agency	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	
DAM AND EMBANKMENT					ac = acres
Top of Dam Elevation, feet msl	1,213.0	1,159.0	946.0	928.0	AF = acre-feet
Length of Dam, feet (net)	6,300	7,487	7,750	9,250	ft = feet
Damming Height, feet (2)	110.2	134	95	114	msl = elevation above mean sea level
Type of Fill	Earth	Earth, Rock	Earth	Earth	cfs = cubic feet per second
Fill Quantity, cubic yards	15,000,000	21,000,000	8,000,000	10,423,000	
SPILLWAY					
Location	Right Abutment	Left Abutment	Left Abutment	Left Abutment	
Crest Elevation, feet msl	1,176.2	1,116.0	922.0	907.4	
Width, feet	1,250	1,059	300	500	
Number, Size, and Type of Gates	None	18 - 40'x20' Tainter	None	None	
Discharge Capacity, Top of Surcharge Pool	560,000 cfs	579,000 cfs	65,000 cfs	44,200 cfs	
RESERVOIR (3)					**TOTALS**
Surcharge Pool Elevation and Area	1,208.2 ft msl 59,886 ac	1,151.4 ft msl 70,030 ac	941.2 ft msl 42,656 ac	921.4 ft msl 18,336 ac	190,908 ac
Flood Control Pool Elevation and Area	1,176.2 ft msl 32,979 ac	1,136.0 ft msl 53,050 ac	920.6 ft msl 25,363 ac	903.4 ft msl 12,890 ac	124,282 ac
Multipurpose Pool Elevation and Area	1,144.4 ft msl 15,709 ac	1,075.0 ft msl 12,617 ac	891.5 ft msl 11,146 ac	875.5 ft msl 7,120 ac	46,592 ac
Surcharge Storage	1,208.2 - 1,176.2 1,442,049 AF	1,151.4 - 1,136.0 939,272 AF	941.2 - 920.6 692,375 AF	921.4 - 903.4 285,809 AF	3,359,505 AF
Flood Control Storage	1,176.2 - 1,144.4 756,669 AF	1,136.0 - 1,075.0 1,870,735 AF	920.6 - 891.5 515,795 AF	903.4 - 875.5 268,783 AF	3,411,982 AF
Multipurpose Storage	1,144.4 - 1,080.0 388,816 AF	1,075.0 - 1,020.0 280,137 AF	891.5 - 835.0 209,513 AF	875.5 - 828.0 125,334 AF	1,003,800 AF
Gross Storage	1,176.2 - 1,080.0 1,145,485 AF	1,136.0 - 1,020.0 2,150,872 AF	920.6 - 835.0 725,308 AF	903.4 - 828.0 394,117 AF	4,415,782 AF
Design Sediment Reserve Storage	160,000 AF for 100 years	240,312 AF for 50 years	140,000 AF for 100 years	28,500 AF for 100 years	
Measured Sediment Inflow	47,935 AF (1967 to 1994)	216,145 AF (1962 to 2000)	49,057 AF (1969 to 1993)	3,421 AF (1977 to 1991)	
OUTLET WORKS					
Location	Right Abutment	Right Abutment	Near Center of Dam	Left Abutment	
River Outlet Type	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	
Number and Size of Conduit	1 - 21'	2 - 20'	1 - 23.5'	1 - 12.5'x13' Arch	
Length of Conduit, feet	615.5	860	592	710	
Entrance Invert Elevation	1,080.0 ft msl	1,003.0 ft msl	833.0 ft msl	828.0 ft msl	
Gated Sluice, Number and Size	None	None	None	None	
Discharge Cap, Top of Flood Control Pool	23,100 cfs	45,900 cfs	27,500 cfs	7,570 cfs	
Discharge Cap, Top of Multipurpose Pool	18,600 cfs	31,300 cfs	21,200 cfs	5,900 cfs	
Service Gates, Number and Size	2 - 10.5'x21'	4 - 10'x20'	2 - 11.75'x23.5'	2 - 6.33'x12.67'	
Emergency Gates, Number and Size	2 - 10.5'x21'	1 - 10'x20'	2 - 11.75'x23.5'	1 - 6.33'x12.67'	
Low Flow Gates, Number and Size	2 - 2'x2'	2 - 24" Butterfly Valve	2 - 2'x2'	1 - 24" Knife Gate Value	
Water Supply Gate, Number and Size	None	None	None	1 - 54"x54" Slide Gate	
Provision for Irrigation	None	None	None	None	
Provision for Power	None	None	None	None	
Provision for Water Supply	No pipe outlets, water supply released to river	No pipe outlets, water supply released to river	No pipe outlets, water supply released to river	36" Steel Pipe	

SUMMARY OF ENGINEERING DATA
LOWER KANSAS RIVER BASIN PROJECTS

U.S. Army Corps of Engineers
Kansas City District
December 2004

Plate 2C

SUBJECT	BONNY RESERVOIR	SWANSON LAKE	ENDERS RESERVOIR	HUGH BUTLER LAKE	HARRY STRUNK LAKE	KEITH SEBELIUS LAKE (Norton Dam)	HARLAN COUNTY LAKE	LOVEWELL RESERVOIR	REMARKS
GENERAL									(1) With pool at MP level.
Location of Dam	Near Hale, CO	Near Trenten, NE	Near Enders, NE	Near McCook, NE	Near Cambridge, NE	Near Norton, KS	Nr Republican City, NE	Near Lovewell, KS	(2) Damming height is
Stream / River	S. Fk Republican River	Republican River	Frenchman Creek	Red Willow Creek	Medicine Creek	Prairie Dog Creek	Republican River	White Rock Creek	from original riverbed to
Miles above Mouth	60.4	359	81.7	18.7	11.9	74.9	232.3	19.3	top of flood control pool.
Contributing Drainage Area, sq mi	1,435	2,506 below Bonny	786	310	642	688	7,169 below u/s dams (5)	358	(3) Based on latest storage
Approx Length of Full Resv, miles	5.5	9.0	6.0	7.5	8.5	9.5	17	11	data. Date of current area
Shoreline, miles (1)	15.0	30	26	35	29	32	54	44	capacity tables given below
Max. Disch. of Record nr Dam Site	103,000 (May 31, 1935)	200,000 (May 31, 1935)	Insufficient Data	30,000 (June 22, 1947)	120,000 (June 1947)	37,500 (May 28, 1953)	260,000 (June 1, 1935)	23,300 (July 10, 1950)	with effective date in ( ).
Date of Closure	July 6, 1950	May 4, 1953	October 23, 1950	September 5, 1961	August 8, 1949	January 28, 1964	July 22, 1951	May 29, 1957	Bonny, Mar 51 (initial)
Date Storage Began	July 6, 1950	May 4, 1953	October 23, 1950	September 5, 1961	August 8, 1949	October 5, 1964	November 14, 1952	October 2, 1957	Swanson, Feb 84 (Jan 84)
Date Multipurpose Level Reached	March 19, 1954	May 15, 1957	January 29, 1952	May 21, 1967	April 2, 1951	June 21, 1967	June 14, 1957	May 20, 1958	Enders, May 97 (Jan 1, 99)
Operating Agency	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Corps of Engineers	Bureau of Reclamation	Butler, May 97 (Jan 1, 99)
DAM AND EMBANKMENT									Strunk, Oct 82 (Feb 1, 83)
Top of Dam Elevation, feet msl	3,742.0	2,793.0	3,137.5	2,634.0	2,415.0	2,347.0	1,982.0	1,616.0	Sebelius, Sep 00 (Jan 02)
Length of Dam, feet (Less Spillway)	9,141.5	8,600	2,242	3,159	5,665	6,344	11,830	8,392	Harlan, Jan 01 (Jan 1, 01)
Damming Height, feet (2)	93.0	80.0	93.0	About 85	86	85.5	98.5	70.3	Lovewell, Jun 95 (Jan 97)
Type of Fill	Earth	Earth	Earth	Earth	Earth	Earth	Earth	Earth	(4) Bartley Div Dam, Rep
Fill Quantity, cubic yards	8,853,000	8,130,000	1,950,000	3,122,000	2,730,000	3,740,000	13,400,000	3,000,000	R. below Red Willow Ck,
SPILLWAY									conc ogee weir w/2-10x16
Location	Left Abutment	Left Abutment	Right Abutment	Right Abutment	Left Abutment	Right Abutment	Center of Dam	Right Abutment	gates to rivr, 2-10'x3' gates
Crest Elevation, feet msl	3,710.0	2,743.0	3,097.0	2,604.9	2,386.2 (see also below)	2,296.0	1,943.5	1,575.3	to canal, max cap 130 cfs.
Width, feet	121.5	142	361	31.5 (circ morning glory)	229	106	856	53	Franklin pumps on Rep R.
Number, Size, and Type of Gates	None (see notes below)	3 - 42' x 30' Radial	6 - 50' x 30' Radial	None	None	3 - 30'x36.35' Radial	18 - 40'x30' Radial	2 - 25'x20' Radial	blw Harlan Cty, cap 40 cfs.
Disch. Cap. Top of Surcharge Pool	73,300 cfs (with sluice)	126,000 cfs	202,000 cfs (with notch)	4,910 cfs	99,000 cfs (with notch)	96,000 cfs	480,000 cfs	35,000 cfs	Courtland Div Dam, Rep R
RESERVOIR (3)									**TOTALS**
Surcharge Pool Elev (ft msl), Area	3,736.2 8,579 ac	2,785.0 10,035 ac	3,129.5 ft msl 2,557 ac	2,628.0 ft msl 4,079 ac	2,408.9 ft msl 5,784 ac	2,341.0 ft msl 6,713 ac	1,975.5 ft msl 24,339 ac	1,610.3 ft msl 7,635 ac	69,721 ac
Flood Cntrl Pool Elev (ft msl), Area	3,710.0 5,036 ac	2,773.0 7,940 ac	3,127.0 ft msl 2,405 ac	2,604.9 ft msl 2,681 ac	2,386.2 ft msl 3,483 ac	2,331.4 ft msl 5,316 ac	1,973.5 ft msl 23,431 ac	1,595.3 ft msl 5,024 ac	55,316 ac
MP, or Top Cons Pool Elev, Area	3,672.0 2,042 ac	2,752.0 4,922 ac	3,112.3 ft msl 1,707 ac	2,581.8 ft msl 1,621 ac	2,366.1 ft msl 1,840 ac	2,304.3 ft msl 2,181 ac	1,945.73 msl 13,305 ac	1,582.6 ft msl 2,987 ac	30,605 ac
Inactive Pool Elev (ft msl), Area	3,638.0 331 ac	2,720.0 1,411 ac	3,082.4 ft msl 627 ac	2,558.0 ft msl 715 ac	2,343.0 ft msl 701 ac	2,280.4 ft msl 575 ac	1,932.5 ft msl 9,282 ac	1,571.7 ft msl 1,495 ac	15,137 ac
Dead Stor Pool Elev (ft msl), Area	3,635.5 242 ac	2,710.0 488 ac	3,080.0 ft msl 567 ac	2,552.0 ft msl 536 ac	2,335.0 ft msl 481 ac	2,275.0 ft msl 317 ac	1,885.0 ft msl 0 ac	1,562.07 ft msl 494 ac	3,125 ac
Surcharge Storage, AF	3,736.2 - 3,710 178,230	2,785 - 2,773 107,610	3,129.5 - 3,127 6,203	2,628.0 - 2,604.9 76,829	2,408.9 - 2,386.2 105660	2,341.0 - 2,331.4 58,287	1,975.5 - 1,973.5 47,767	1,610.3 - 1,595.3 94,145	674,731 AF
Flood Control Storage, AF	3,710.0 - 3,672 128,820	2,773 - 2,752 134,077	3,127.0 - 3,112.3 30,048	2,604.9 - 2,581.8 48,846	2,386.2-2,366.1 52,715	2,331.4 - 2,304.3 99,230	1,973.5 - 45.73 500,000	1,595.3 - 1,582.6 50,465	1,044,201 AF
MP, or Active Conserv Storage, AF	3,672.0 - 3,638 39,206	2,752 - 2,720 99,784	3,112.3 - 3,082.4 33,962	2,581.8 - 2,558 27,303	2,366.1 - 2,343 26,846	2,304.3 - 2,280.4 30,517	1,945.73 - 32.5 150,000	1,582.6 - 1,571.7 24,022	431,640 AF
Inactive Storage, AF	3,638.0 - 3,635.5 716	2,720 - 2,710 10,312	3,082.4 - 3,080 1,432	2,558.0 - 2,552 3,736	2,343.0 - 2,335 4,699	2,280.4 - 2,275 2,357	1,932.5 - 1,890 164,111	1,571.7 - 1,562.07 9,985	197,348 AF
Dead Storage, AF	3,635.5 - 3,617 1,418	2,710 - 2,701 2,118	3,080.0 - 3,050 7,516	2,552.0 - 2,527 5,185	2,335.0 - 2,318.5 4,160	2,275.0 - 2,262 1,636	Sluice crest at 1,885 0	1,562.07 - 1,550.0 1,659	23,692 AF
Gross Storage, AF	3,710.0 - 3,617 170,160	2,773 - 2,701 246,291	3,127.0 - 3,050 72,958	2,604.9 - 2,527 85,070	2,386.2 - 2,318.5 88,420	2,331.4 - 2,262 133,740	1,973.5 - 1,890 814,111	1,595.3 - 1,550.0 86,131	1,696,881 AF
Design Sediment Reserve Storage	8,000 AF for 50 years	51,000 AF for 50 years	4,000 AF for 100 years	10,000 AF for 50 years	15,000 AF for 50 years	6,000 AF for 50 years	200,000 AF for 100 yrs	8,000 AF for 50 years	
Measured Sediment Inflow	160 AF/year (estimated)	7,659 AF (1953 to 1982)	1,572 AF (1950 to 1997)	1,616AF (1961 to 1997)	4,397 AF (1949 to 1981)	1,617 AF (1964 to 2000)	38,548 AF (1952 - 00)	6,021 AF (1957 to 1995)	
OUTLET WORKS									at Guide Rock, conc ogee
Location	Left Abutment	Left Abutment	Right Abutment	Right Abutment	Right Abutment	Left Abutment	Center of Dam	Right Abutment	w/2-20'x12' gates to river
River Outlet Type	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	Gated Sluices	Spillway gates used for	5-10'x6'gates to Courtland
Number and Size of Conduit	1 – 56" Cond to 26" Pipe	2 - 6' x 7.5'	1 - 84" Cond to 84"Pipe	1 - 82"	1 – 84" Cond to 44" Pipe	1 – 48" Cond to 38" Pipe	9 - 5'x8' thru Spillway	river releases. Gated	canal (cap 751 cfs), 1-10x6
Length of Conduit, feet	831.5	86.74	516	553.5	553	495 to Gate, 145 to Basin		wasteway with 1-10'x9'	gate to Superior (cap 139).
Entrance Crest Elevation	3,635.5 ft msl	2,710.0 ft msl	3,080.0 ft msl	2,552.0 ft msl	2,335.0 ft msl	2,275.0 ft msl	1,885.0 ft msl	radial gate from outlet	Other private diversion
Disch Cap, Top of Flood Cntrl Pool	140 cfs (approx)	4,300 cfs	1,430 cfs	1,170 cfs	398 cfs (max elev 2,379)	312 cfs	20,700 cfs	canal to stilling basin.	weirs exist on some creeks
Disch Cap, Top of MP (Consv) Pool	103 cfs	3,500 cfs	1,300 cfs	990 cfs	361 cfs	257 cfs	17,370 cfs	Wasteway is not used.	like Riverside blw Enders
Service Gates, Number, Size, Type	1 - 24" Hollow Jet Valve	2 - 6' x 7.5' Slide Gates	2-60" Hollow Jet Valves	2 - 42" Slide Gates	1 - 39" Slide Gate	1 - 33" Slide Gate	9 - 5' x 8' Slide Gates	None	but div capacity minimal.
Provision for Irrigation	1 - 32" Pipe to 24" Valve	1 - 56" Pipe to 4' Gate	None	None	None	None	1-5.5'; 1-2.83' Conduits	1 - 8'x10' Gated Outlet	(5) 13,536 sq mi total
Provision for Power	None	None	None	None	None	None	12'x12' Plug for 9' Cond	None	contributing with u/s dams.
Provision for Municipal Supply	None	None	None	None	None	1 - 16" Pipe to 16" Gate	None	None	ac = acres ft = feet
Other Outlet	1 - 40" Capped Conduit	None	None	None	None	None	1-18" outlet for low flow	Note: Inflow to lake also	AF = acre-feet
							regulation in mono 20.	provided from gated	cfs = cubic feet per sec
	Notes: Spillway also has 16.5'x21.5' sluice, with 1 - 16.5' x 10.75'gate, crest elev 3,672.0. The 56" gated outlet conduit feeds all three gated sub outlets. Capacity of irrig pipe outlet limited to 34.5 cfs by canal cap.	Notes: Irrigation outlet in right abutment.	Notes: Spillway has an uncontrolled notch w/ crest elevation at 3112.3. Concrete ogee weir diversion dam 52 miles d/s, w/ 2-14' x 9.5' gates plus 30" gated condut to river, and 2- 10'x6' gates to canal (cap 400 cfs).	Note: Concrete ogee weir diversion dam 13 miles downstream, w/ 1-6'x18' radial gate to river, and 2 - 5'x4' regulating gates to canal (max cap 90 cfs) Bartley Diversion Dam located below Rep. R. confluence. See note (4)	Notes: Spillway also has an uncontrolled notch w/ crest elevation at 2366.1. Concrete ogee weir div-ersion dam at mile 301.6 on Rep. R. blw Med Ck. 2-10'x14'gates to river and 4-10'x14' gates to canal (max cap 325 cfs).	Notes: Concrete ogee weir diversion dam 17.6 miles downstream, with 1 – 6'x18' radial gate to river, 2 – 6'x5' gates to Main Canal (cap 100 cfs) and 2 – 5'x4' gates to South Canal (capacity 36 cfs).	Franklin Canal conduit to 2-36" gates, cap 520 cfs. Naponee Canal conduit to 1-24" valve, cap 40 cfs. See also note (4)	Courtland Canal outlet.	msl = elev abv mean sea lvl

SUMMARY OF ENGINEERING DATA
REPUBLICAN RIVER BASIN PROJECTS

U.S. Army Corps of Engineers
Kansas City District
December 2004

Plate 2D

SUBJECT	WACONDA LAKE	KIRWIN RESERVOIR	WEBSTER RESERVOIR	WILSON LAKE	KANOPOLIS LAKE	CEDAR BLUFF RESERVOIR	REMARKS
GENERAL							(1) With pool at multipurpose or full conservation level. (2) Damming height is height from original river bed to top of flood control pool. (3) Based on latest available storage data. The dates of the current area - capacity tables are indicated below along with the effective dates in parenthesis: Waconda, July 2001 (effective January 1, 2003) Kirwin, May 1996 (effective January 1, 1998) Webster, May 1996 (effective January 1, 1998) Wilson, December 1984 (effective January 1, 1985) Kanopolis, February 1983 (effective March 1, 1983) Cedar Bluff, March 2001 (effective January 1, 2002) (4) Total DA with Kirwin and Webster = 5,076 sq miles (5) 7' conduit from intake tower to gate chamber. 4'x5' emergency gate to 60" pipe. Entrance to stilling well controlled by 4'x5' slide gate. From stilling well, 42" river outlet pipe controlled by 36" gate. River outlet capacity at top of MP pool and flood control pool about 220 cfs. Length of combined pipes from intake to stilling well about 500'. About 200' more to stilling basin. Canal releases from two openings at top of stilling well. Canal capacity is about 175 cfs, but combined capacity with river outlet about 395 cfs. (6) Total contrib. DA with Cedar Bluff = 7,695 sq miles
Location of Dam	Near Glen Elder, KS	Near Kirwin, KS	Near Stockton, KS	Near Wilson, KS	Near Ellsworth, KS	Near Ellis, KS	
Stream / River	Solomon River	North Fork Solomon River	South Fork Solomon River	Saline River	Smoky Hill River	Smoky Hill River	
Miles above Mouth	172.4	67.8	92.4	153.9	183.7	333.4	
Contributing Drainage Area, sq miles	2,559 below u/s dams (4)	1,367	1,150	1,917	2,330 blw Cedar Bluff (6)	5,365	
Approx Length of Full Reservoir, miles (1)	24	9	7	24	12	9	
Shoreline, miles (1)	100	37	27	100	41	50	
Maximum Discharge of Record nr Dam Site	125,000 cfs (July 1951)	24,000 cfs (Sep 1919)	55,200 cfs (July 1951)	25,700 cfs (Jul-Aug 1928)	61,000 cfs (June 1938)	98,000 cfs (May 1938)	
Date of Closure	October 18, 1967	March 7, 1955	May 3, 1956	September 3, 1963	July 26, 1946	November 13, 1950	
Date Storage Began	July 24, 1968	October 5, 1955	May 3, 1956	December 29, 1964	February 17, 1948	November 13, 1950	
Date Multipurpose Level Reached	May 16, 1973	July 2, 1957	June 18, 1957	March 12, 1973	July 19, 1948	June 21, 1951	
Operating Agency	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Corps of Engineers	Corps of Engineers	Bureau of Reclamation	
DAM AND EMBANKMENT							
Top of Dam Elevation, feet msl	1,500.0	1,779.0	1,944.0	1,592.0	1,537.0	2,198.0	
Length of Dam, feet (Less Spillway)	14,631	12,246	10,604	5,600	15,360	12,409.5	
Damming Height, feet (2)	107.9	95	84.7	114	102	102	
Type of Fill	Earth	Earth	Earth	Earth	Earth	Earth	
Fill Quantity, cubic yards	8,050,000	9,537,000	8,145,000	8,500,000	15,200,000	8,490,000	
SPILLWAY							
Location	Right Abutment	Right Abutment	Left Abutment	Right Abutment	Right Abutment	Right Abutment	
Crest Elevation, feet msl	1,467.4	1,757.3	1,884.6	1,582.0	1,507.0	2,166.0	
Width, feet	644	400 (uncontrolled)	116	450 (uncontrolled)	500 (uncontrolled)	150.5 (uncontrolled length)	
Number, Size, and Type of Gates	12 - 50'x21.76' Radial	None, but see note below	3 – 33.33'x39.51' Radial	None	None	Gated orifice, see note blw	
Discharge Capacity at Top of Surcharge Pool	278,000 cfs	96,000 cfs (sluices closed)	138,000 cfs	15,700 cfs	172,000 cfs	84,000 cfs (with orifice)	
RESERVOIR (3)							**TOTALS**
Surcharge Pool Elevation (ft msl), Area	1,492.9 ft msl 38,178 ac	1,773.0 ft msl 14,660 ac	1,938.0 ft msl 11,270 ac	1,587.5 ft msl 33,882 ac	1,531.8 ft msl 23,408 ac	2,192.0 ft msl 16,510 ac	137,908 ac
Flood Control Pool Elevation (ft msl), Area	1,488.3 ft msl 33,682 ac	1,757.3 ft msl 10,639 ac	1,923.7 ft msl 8,478 ac	1,554.0 ft msl 20,027 ac	1,508.0 ft msl 13,958 ac	2,166.0 ft msl 10,790 ac	97,574 ac
Multipurpose, or Top Cons Pool Elev, Area	1,455.6 ft msl 12,602 ac	1,729.25 ft msl 5,071 ac	1,892.45 ft msl 3,767 ac	1,516.0 ft msl 9,045 ac	1,463.0 ft msl 3,406 ac	2,144.0 ft msl 6,869 ac	40,760 ac
Inactive Pool Elevation (ft msl), Area	1,428.0 ft msl 3,020 ac	1,697.0 ft msl 1,006 ac	1,860.0 ft msl 904 ac			2,107.8 ft msl 1,907 ac	
Dead Storage Pool Elevation (ft msl), Area	1,407.8 ft msl 248 ac	1,693.0 ft msl 765 ac	1,855.5 ft msl 440 ac			2,090.0 ft msl 755 ac	
Surcharge Storage, AF	1,492.9 - 1,488.3 203,798	1,773.0 - 1,757.3 198,467	1,938.0 - 1,923.7 140,912	1,587.5 - 1,554.0 894,263	1,531.8 - 1,508.0 438,655	2,192.0 - 2,166.0 353,250	2,229,345 AF
Flood Control Storage, AF	1,488.3 - 1,455.6 722,988	1,757.3 - 1,729.25 215,136	1,923.7 - 1,892.45 183,353	1,554.0 - 1,516.0 530,204	1,508.0 - 1,463.0 369,278	2,166.0 - 2,144.0 191,890	2,212,849 AF
MP, or Active Conservation Storage, AF	1,455.6 - 1,428.0 193,183	1,729.25 - 1,697.0 89,639	1,892.45-1,860.0 71,926	1,516.0 - 1,435.0 242,528	1,463.0 - 1,430.0 49,474	2,144.0 - 2,107.8 143,878	790,628 AF
Inactive Storage, AF	1,428.0 - 1,407.8 25,989	1,697.0 - 1,693.0 3,546	1,860.0 - 1,855.5 2,975			2,107.8 - 2,090.0 24,172	56,682 AF
Dead Storage, AF	1,407.8 - 1,395.0 248	1,693.0 - 1,680.0 4,969	1,855.5 - 1,849.0 1,256			2,090.0 - 2,078.0 4,402	10,875 AF
Gross Storage, AF	1,488.3 - 1,395.0 942,408	1,757.3 - 1,680.0 313,290	1,923.7 - 1,849.0 259,510	1,554.0 - 1,435.0 772,732	1,508.0 - 1,430.0 418,752	2,166.0 - 2,078.0 364,342	3,071,034 AF
Design Sediment Reserve Storage	23,750 AF for 50 years	14,950 AF for 100 years	18,600 AF for 100 years	40,000 AF for 100 years	51,500 AF for 50 years	26,000 AF for 100 years	
Measured Sediment Inflow	22,597 AF (1968 to 2001)	1,278 AF (1955 to 1996)	1,267 AF (1956 to 1996)	15,066 AF (1964 to 1995)	28,704 AF (1948 to 1993)	13,044 AF (1950 to 2000)	
OUTLET WORKS							(7) In addition to the gated conduit, Kanopolis has an uncontrolled port opening 3.5'x13.75' in the 10' pier separating the two service gate openings. Crest elevation of the port is 1,463 ft msl. The max discharges given for the outlet is the combined total of the port and gates. (8) River outlet crest elev is 2,090 ft msl. Crest elev of sluices under spillway is 2,134.82 ft msl. River outlet capacity at MP is 804 cfs, at top of flood pool is 909 cfs. Cedar Bluff also has an irrig canal outlet on Y junction from river outlet, 5.5' pipe to control house, canal flow controlled by 4'x5' gate (not used since 1978, irrigation district disbanded in 1994). Also a hatchery supply line from 18" valve on canal outlet, capacity 10 cfs. Lake storage owned by KS, for benefit of recreation and F&W. All releases coordinated with Kansas KDWP. (9) 2,000 AF annual storage supply contract for Russell.
Location	Left Abutment	Center of Dam	Right Abutment	Right Abutment	Right Abutment	Left Abutment	
River Outlet Type	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit (7)	Gated Conduit to River	
Number and Size of Conduit	1 - 12.5'	7' Cond to 60" pipe (5)	4.5' Conduit to 48" pipe	1 - 12'	1 - 14'	1 - 5.5'	
Length of Conduit, feet	575	(5)	538	1,097	2,443	863.5	
Entrance Crest Elevation	1,407.8 ft msl	1,693 ft msl	1,855.5 ft msl	1,450.0 ft msl	1,415.0 ft msl	2,090.0 ft msl	
Gated Sluice, Number and Size	None	See note below	None	None	None	8 - 5'x5', gated (8)	
Discharge Cap, Top of Flood Control Pool	5,200 cfs	220 cfs (5)	480 cfs	6,500 cfs	6,400 cfs (7)	3,520 cfs (outlet, sluices) (8)	
Disch Cap, Top of MP (Conservation) Pool	4,000 cfs	220 cfs (5)	385 cfs	5,300 cfs	4,500 cfs (7)	7,949 cfs (outlet, sluices) (8)	
Service Gates, Number, Size, Type	2 - 6.5'x8' Slide Gates	1 - 4'x5' to stilling well (5)	1 - 3.5'x3.5' Slide Gate	2 - 6'x12' Service Gates	2 - 6'x12'	1 - 4'x5'	
Emergency Gates, Number and Size	1 - 9'x12' Slide Gates	1 - 4'x5' (5)	1 - 3.5'x3.5' Slide Gate	2 - 6'x12' Slide Gates	1 - 6'x12'	1 - 4'x5'	
Low Flow Gates, Number and Size	None	None	None	2 - 2'x2' Slide Gates	None	None	
Provision for Irrigation	None	2 - 5.5'x8' openings (5)	None	None	None	1 - 4'x5' (8)	
Provision for Power	None	None	None	None	Provision future penstock	None	
Provision for Municipal Supply	No pipe outlets, water supply released to river	None	None	None	Pump outlet near tower	See (9), supplied by release to river, pump to Big Ck.	
		Note: 15 - 5' x 5' gated sluices located in concrete ogee section below spillway crest. Crest elevation at sluice entrance = 1,720.0. Discharge capacity at top of conserv pool = 4,800 cfs, top, flood pool = 15,350 cfs.	Note: When reservoir elevation is below 1,860, the outlet gate openings must be reduced to prevent air entrainment in conduit.	Note: Low flow gates are mounted in the service gates		Note: Spillway also has a gated orifice section at center with 1 - 14.5' x 9.58' radial gate, crest elev 2,144. Spillway cap includes ogee and orifice. Sluices located in ogee section below crest.	

Abbreviations
ac = acres
AF = acre-feet
ft = feet
msl = elevation above mean sea level
cfs = cubic feet per second
MP = multipurpose pool elevation

SUMMARY OF ENGINEERING DATA
SMOKY HILL RIVER BASIN PROJECTS

U.S. Army Corps of Engineers
Kansas City District
December 2004

Plate 2E

APPENDIX A
CORPS OF ENGINEERS PROJECTS

BLUE SPRINGS LAKE

CLINTON LAKE

HARLAN COUNTY LAKE

HARRY S TRUMAN RESERVOIR

HILLSDALE LAKE

KANOPOLIS LAKE

LONG BRANCH LAKE

LONGVIEW LAKE

MELVERN LAKE

MILFORD LAKE

PERRY LAKE

POMME DE TERRE LAKE

POMONA LAKE

RATHBUN LAKE

SMITHVILLE LAKE

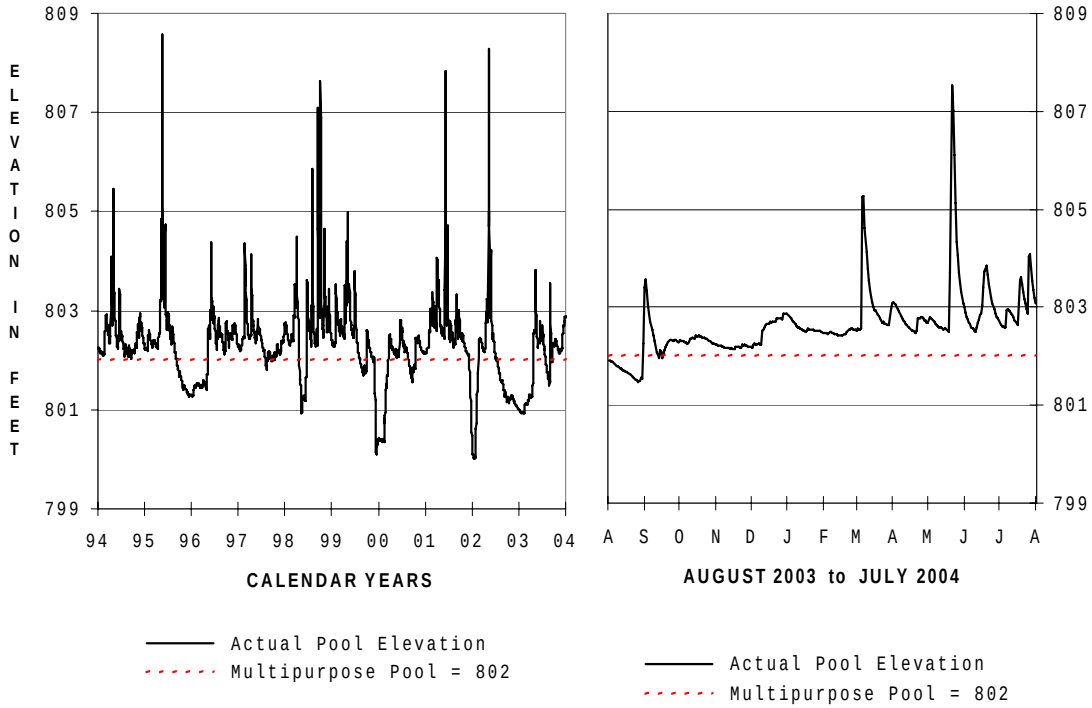
STOCKTON LAKE

TUTTLE CREEK LAKE

WILSON LAKE

BLUE SPRINGS LAKE
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

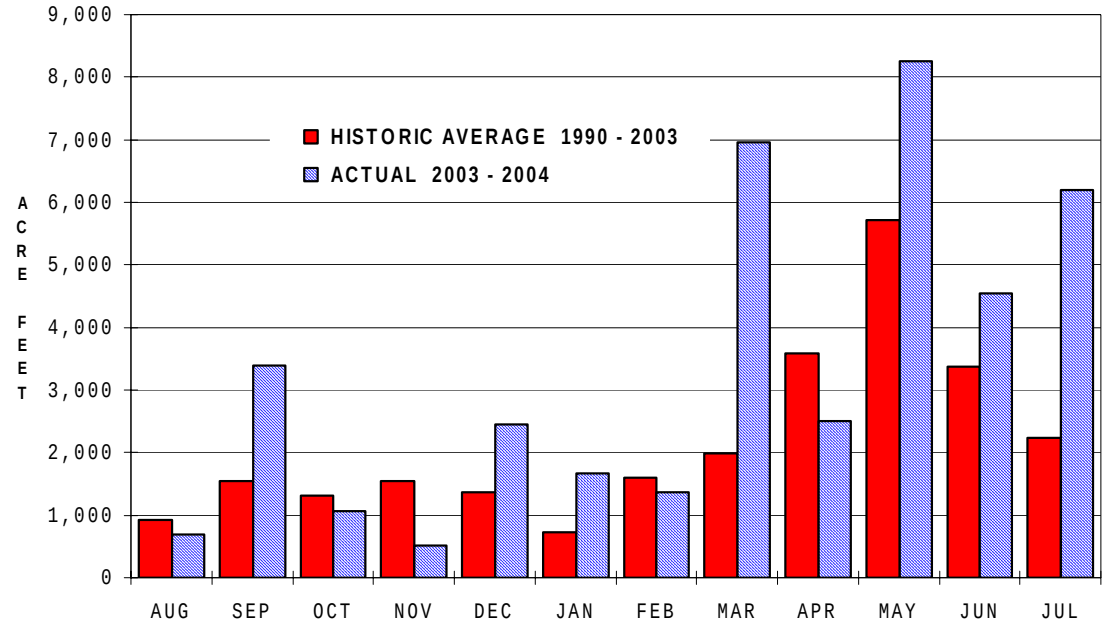


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
801.92 1 Aug 03	**803.08 31 Jul 04**	**807.52 20 May 04**	**801.48 26 Aug 03**	**816.37 16-17 May 90**	**800.10 14-15 Dec 99**

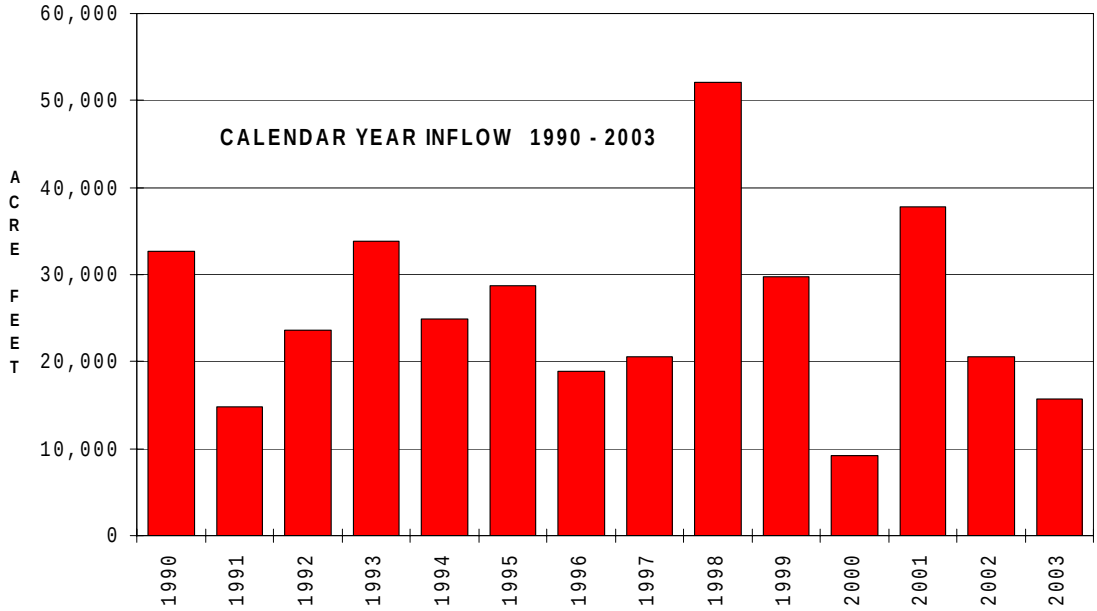
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
1,860 20 May 04	**39,588**	**511 20 May 04**	**0 Many days**

All releases are to the river. No minimum release requirement.

BLUE SPRINGS LAKE MONTHLY INFLOW

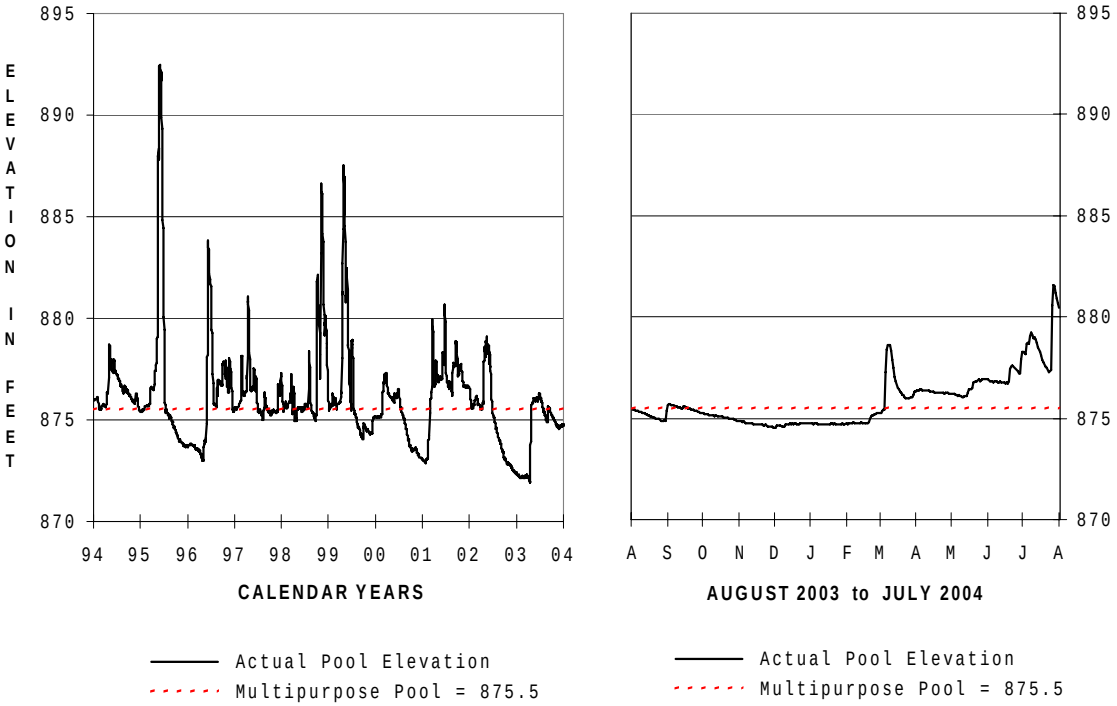


BLUE SPRINGS LAKE ANNUAL INFLOW



CLINTON LAKE
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

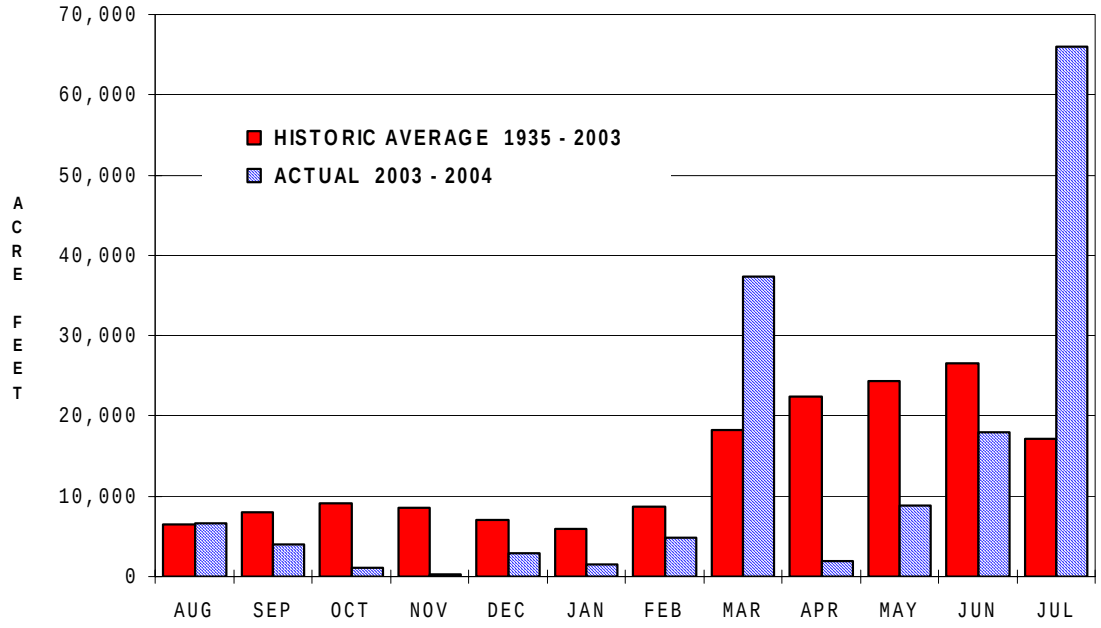


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
875.43 1 Aug 03	**880.45 31 Jul 04**	**881.57 26 Jul 04**	**874.53 2 Dec 03**	**892.48 29 May 95**	**871.60 18-19 Aug 89**

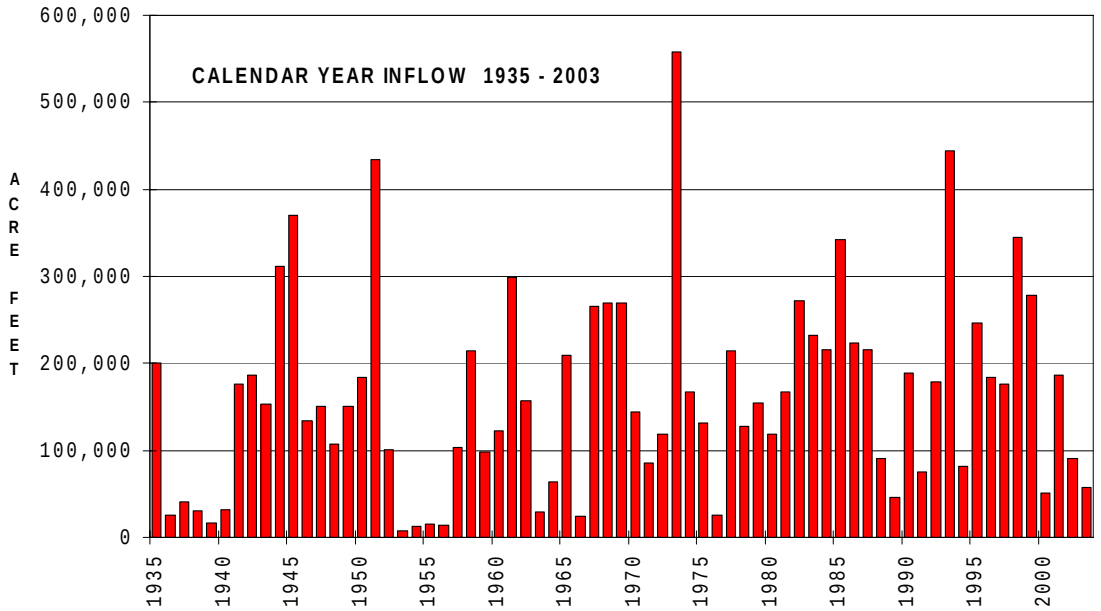
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
12,500 25 Jul 04	**153,539**	**2,060 10 Mar 04**	**0 30 Oct 03**

Outflows are those to river only. Minimum release is 7 to 21 cfs. Releases cut to 0 for short maintenance periods.

CLINTON LAKE MONTHLY INFLOW

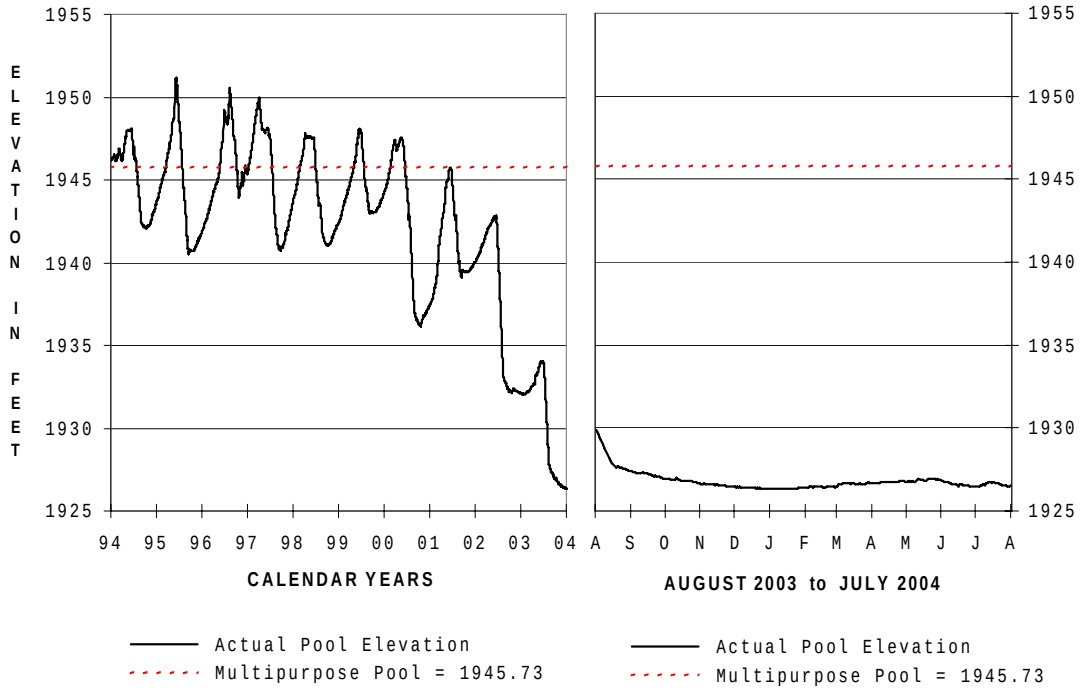


CLINTON LAKE ANNUAL INFLOW



HARLAN COUNTY LAKE
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

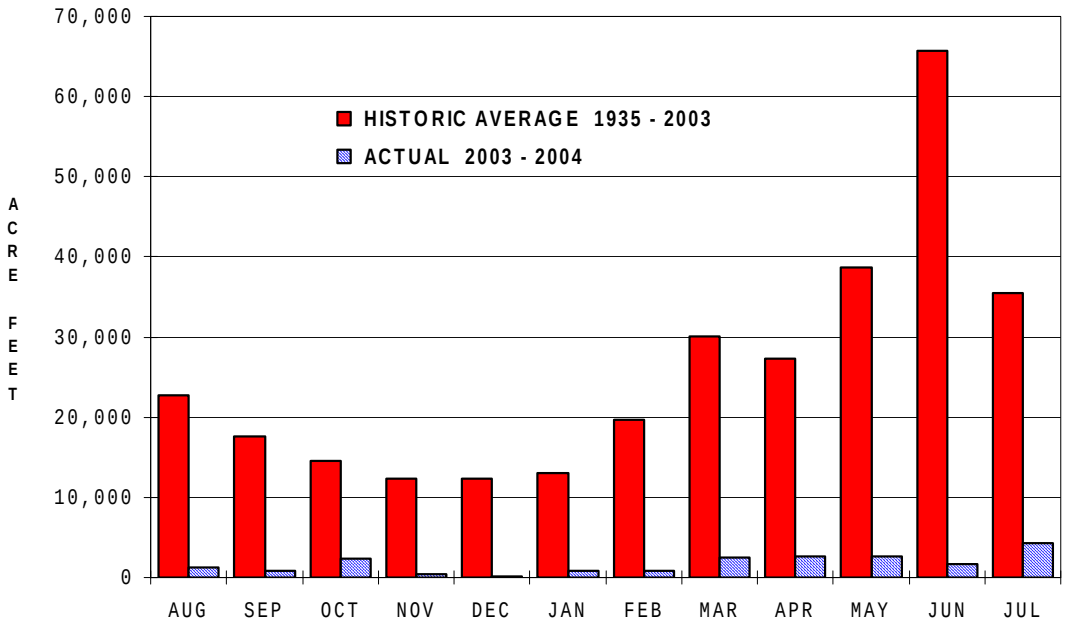


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1929.86 1 Aug 03	**1926.53 31 Jul 04**	**1929.86 1 Aug 03**	**1926.34 20 Jan 04**	**1955.66 5 Apr 60**	**1926.34 20 Jan 04**

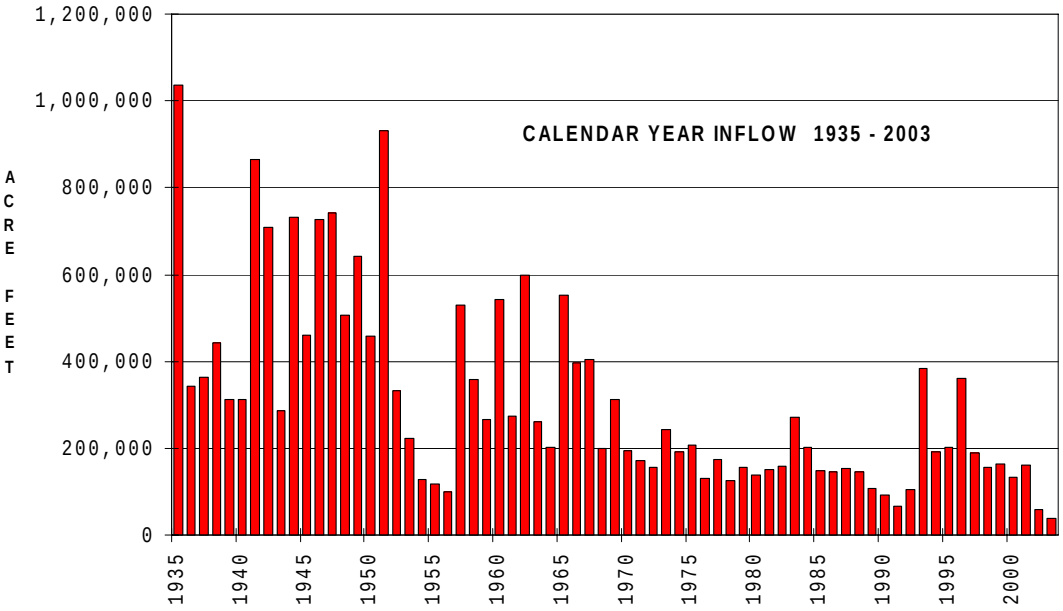
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
400 1 Mar 04	**20,295**	**350 1 Aug 03**	**0 Many days**

Max daily outflow to river occurred as part of normal releases for irrigation.

HARLAN COUNTY LAKE MONTHLY INFLOW

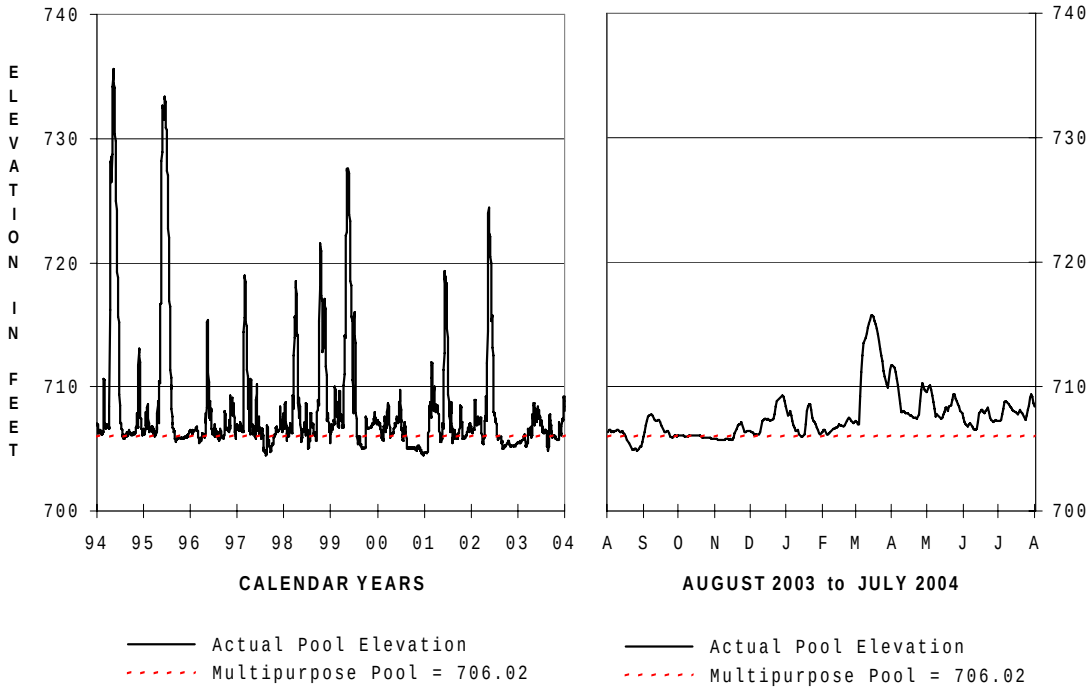


HARLAN COUNTY LAKE ANNUAL INFLOW



HARRY S TRUMAN RESERVOIR
2003 - 2004 REGULATION

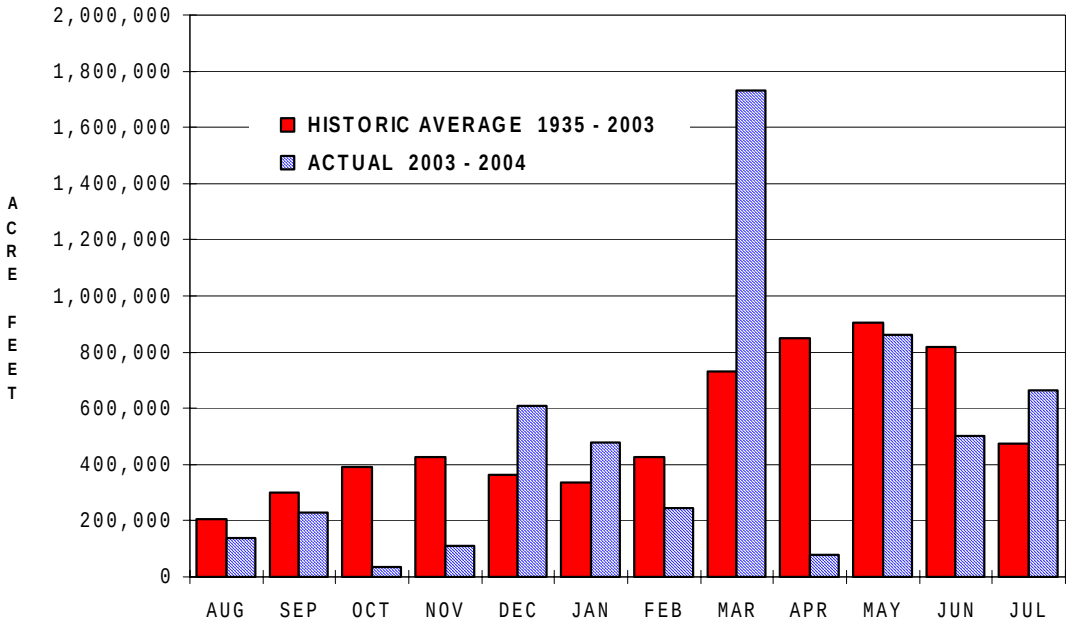
A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



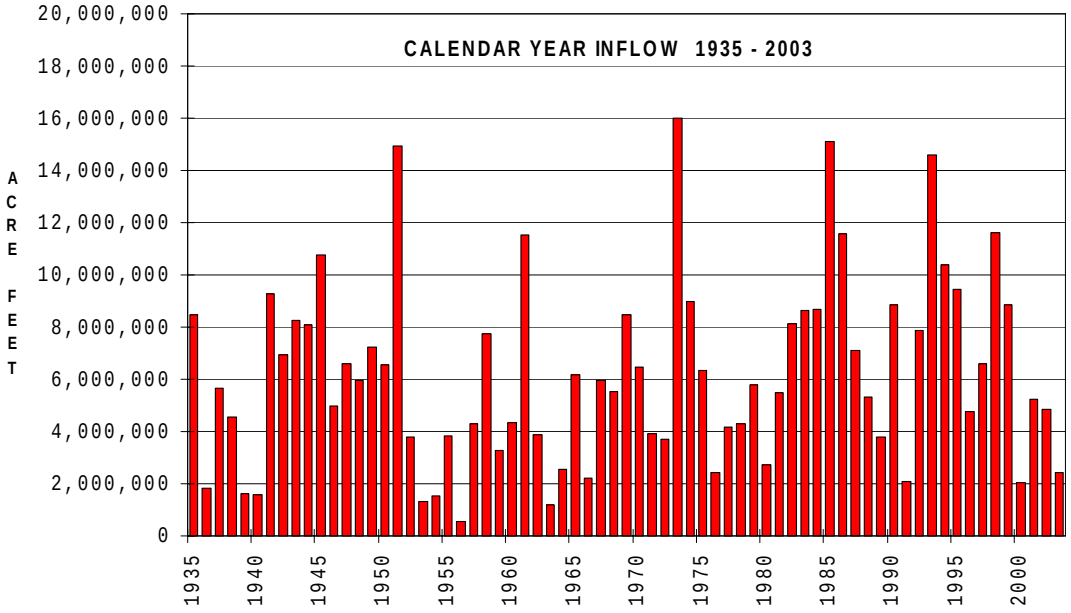
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
706.38 1 Aug 03	**708.41 31 Jul 04**	**715.72 15 Mar 04**	**704.85 22 Aug 03**	**738.72 12 Oct 86**	**703.42 10 Apr 81**

Report Period Inflow and Outflow			
Max Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
71,000 6 Mar 04	**5,688,870**	**34,000 2 Apr 04**	**0 Many days**

HARRY S. TRUMAN RESERVOIR MONTHLY INFLOW

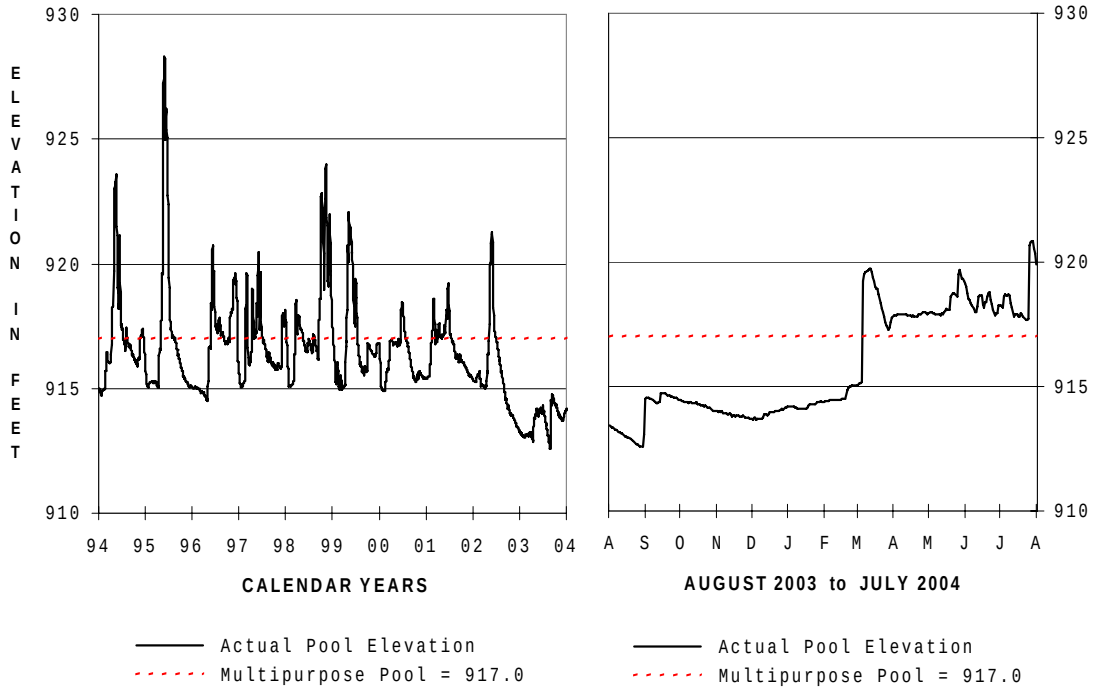


HARRY S. TRUMAN RESERVOIR ANNUAL INFLOW



HILLSDALE LAKE
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

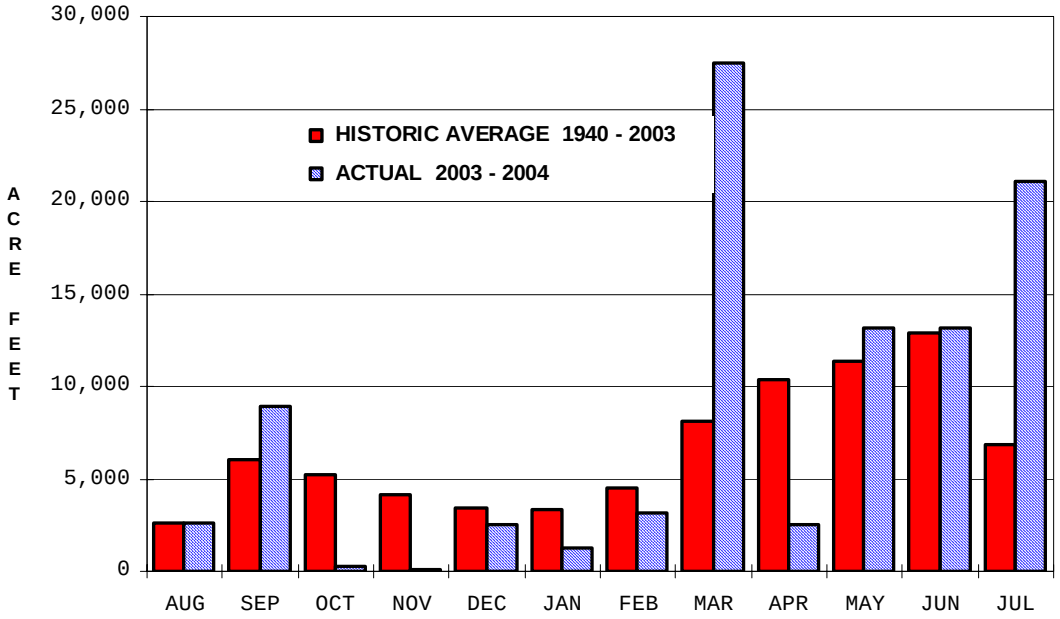


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
913.42 1 Aug 03	**919.89 31 Jul 04**	**920.83 27 Jul 04**	**912.57 30 Aug 03**	**928.51 21 Oct 86**	**904.97 14-15 Nov 87**

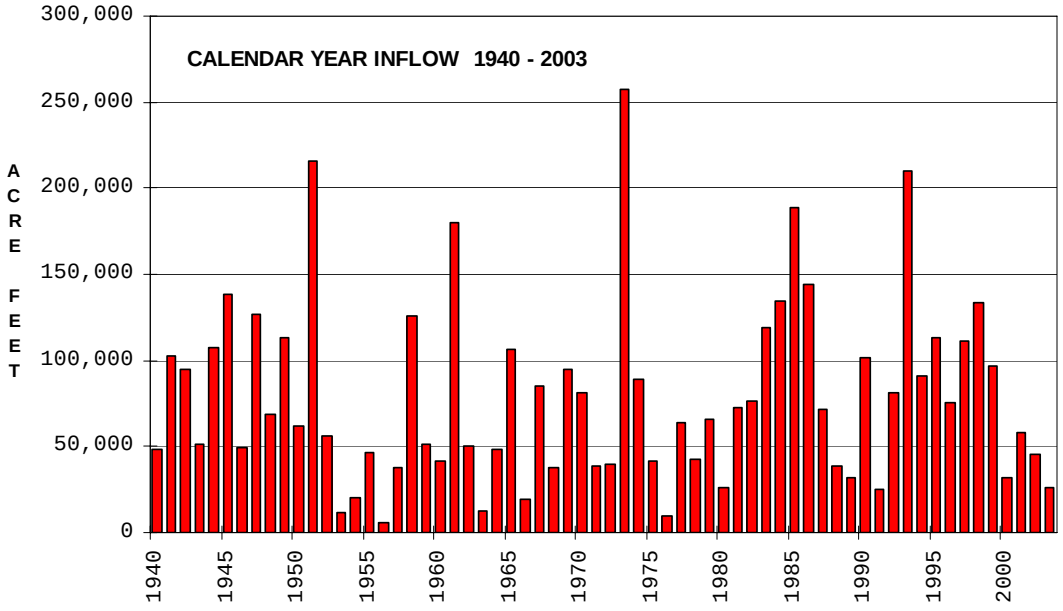
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
9,600 6 Mar 04	**96,222**	**740 31 Jul 04**	**0 26 Jul 04**

Minimum required release varies seasonally 3 to 24 cfs. Releases cut to 0 for short maintenance periods.

HILLSDALE LAKE MONTHLY INFLOW

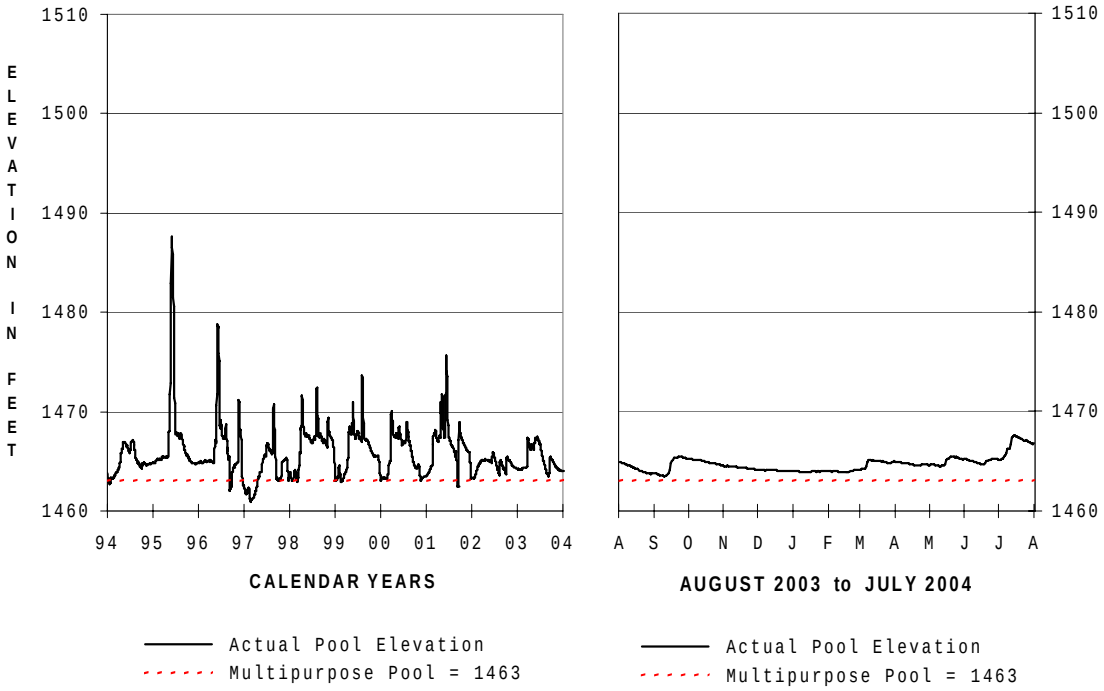


HILLSDALE LAKE ANNUAL INFLOW



KANOPOLIS LAKE
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

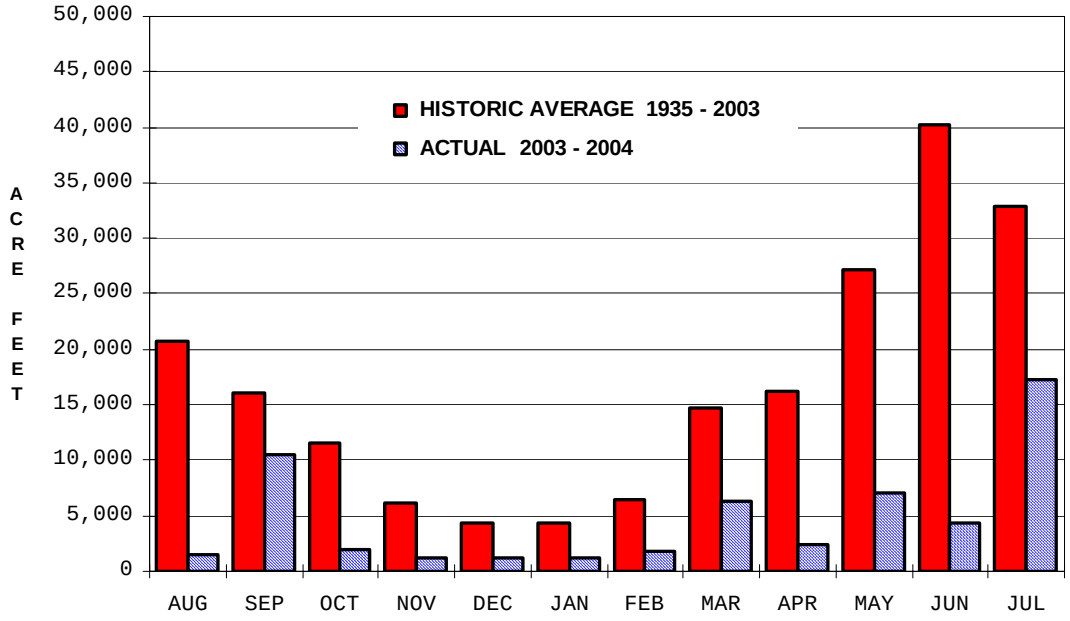


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1464.90 1 Aug 03	**1466.81 31 Jul 04**	**1467.55 14 Jul 04**	**1463.50 10 Sep 03**	**1506.98 14 Jul 51**	**1452.55 11 Dec 88**

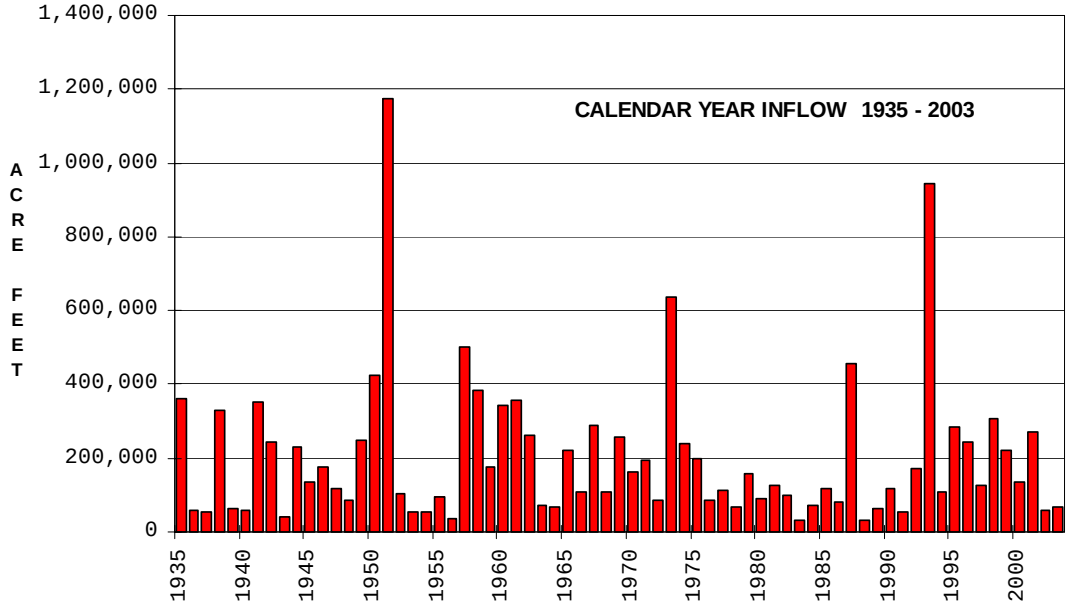
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
1,500 10 Jul 04	**56,777**	**180 14 Jun 04**	**20 10 Jan 04**

Outflows are total from the gates and the uncontrolled notch. Minimum release varies seasonally 10 to 50 cfs.

KANOPOLIS LAKE MONTHLY INFLOW

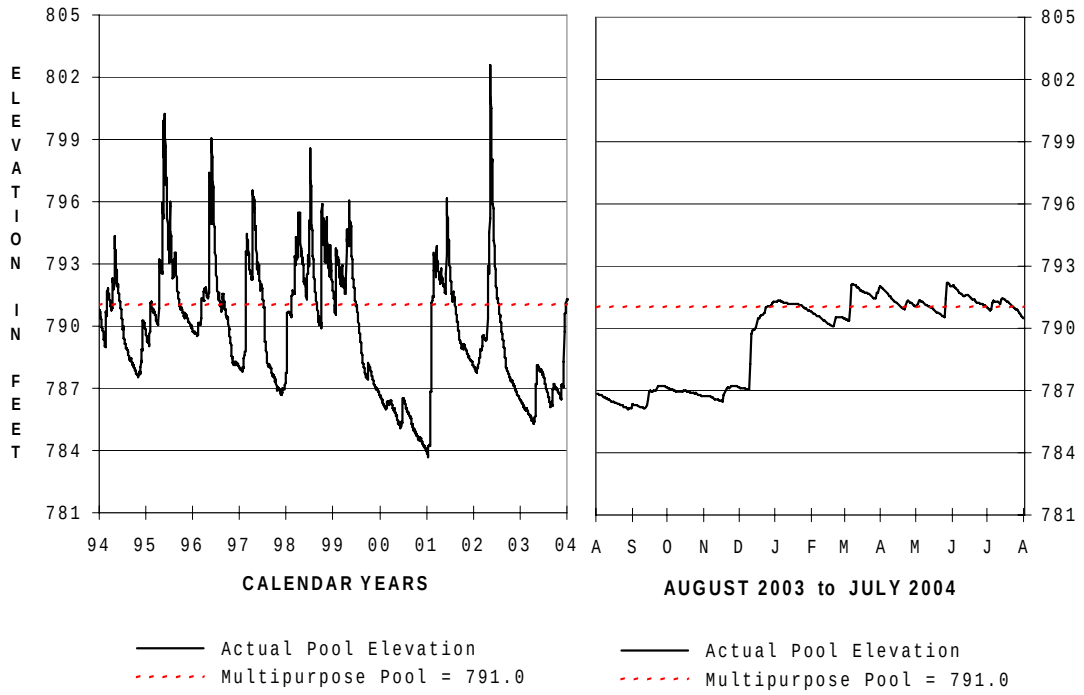


KANOPOLIS LAKE ANNUAL INFLOW



LONG BRANCH LAKE
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

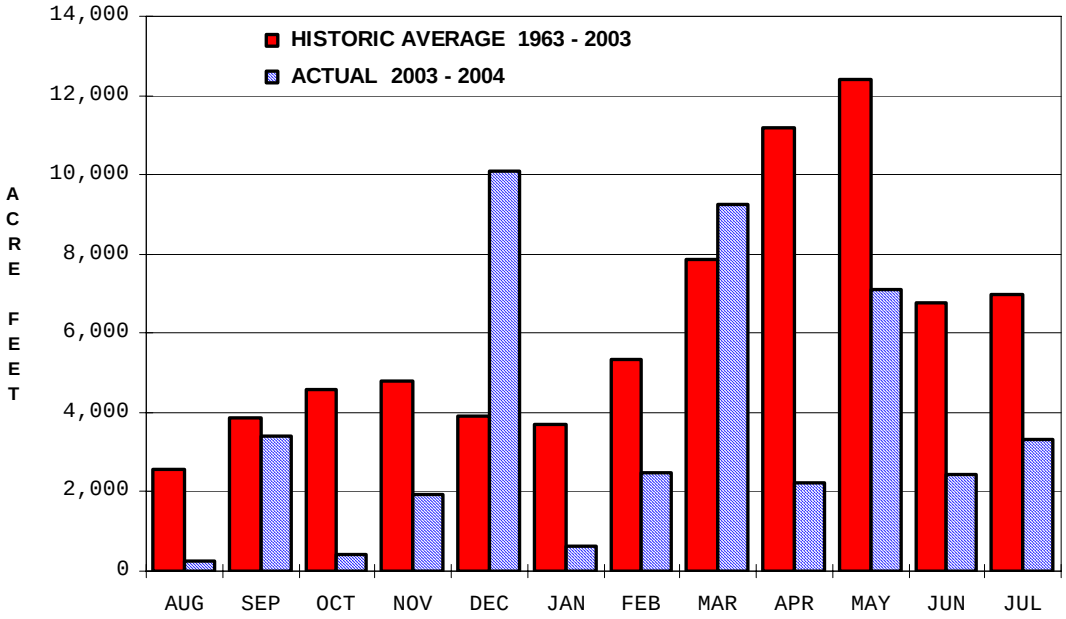


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
786.85 1 Aug 03	**790.50 31 Jul 04**	**792.21 26 May 04**	**786.21 28 Aug 03**	**802.74 13 May 02**	**783.70 12 Jan 01**

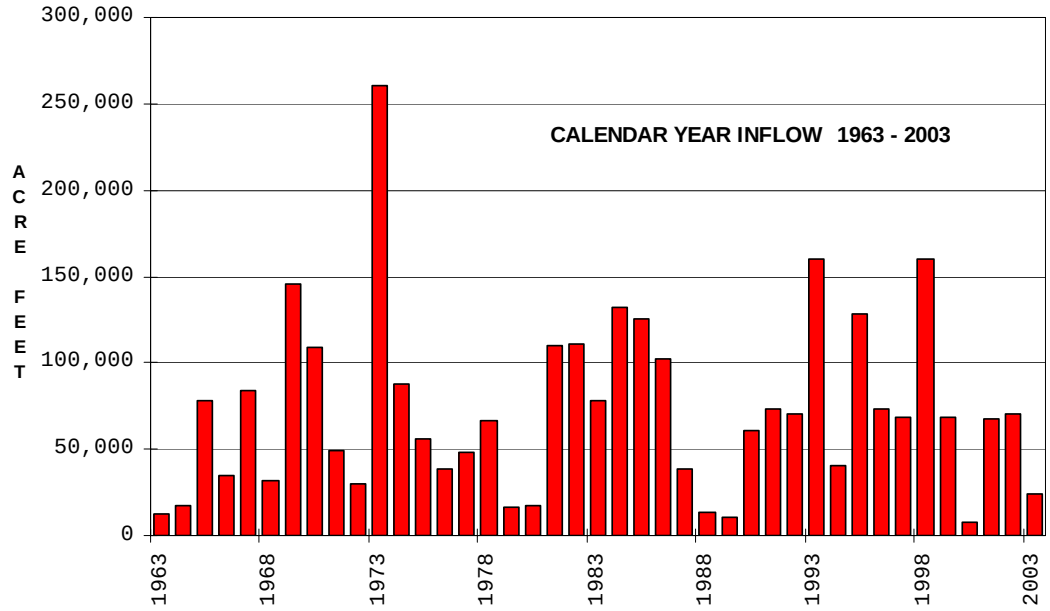
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
1,650 11 Dec 03	**43,490**	**116 27 May 04**	**7 Many days**

Listed outflows are total to the river from the gates and the uncontrolled notch. Minimum required release is 7 cfs.

LONG BRANCH LAKE MONTHLY INFLOW

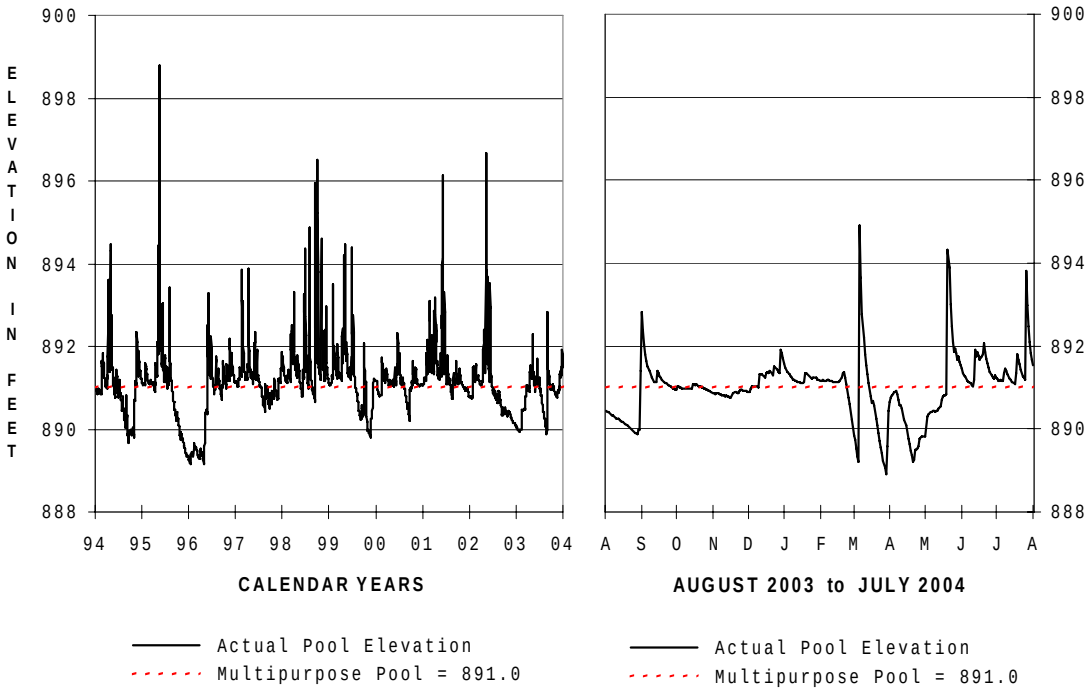


LONG BRANCH LAKE ANNUAL INFLOW



LONGVIEW LAKE
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

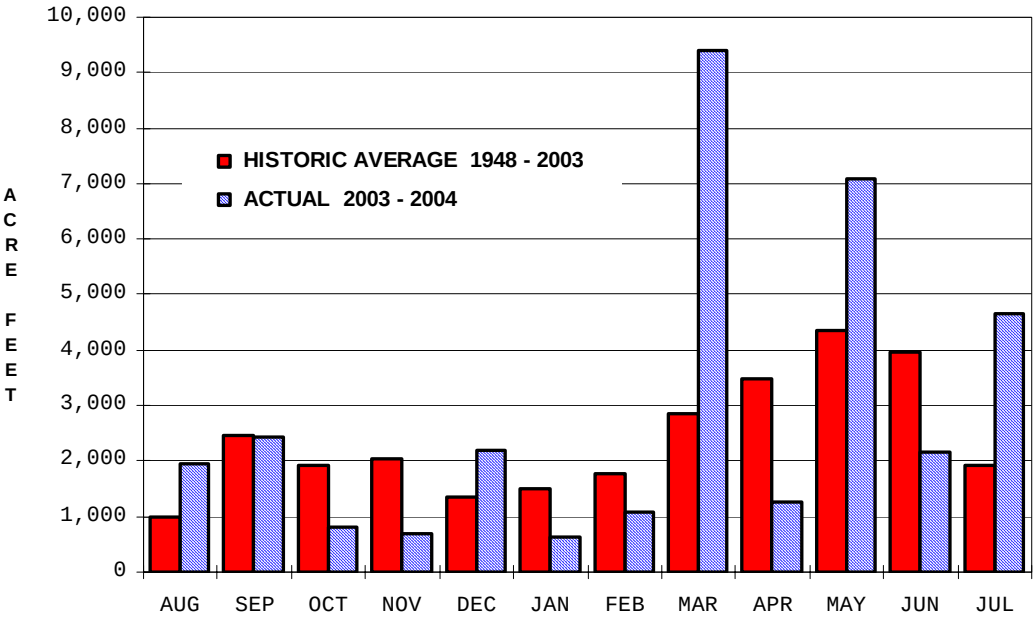


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
890.43 1 Aug 03	**891.54 31 Jul 04**	**894.90 5 Mar 04**	**888.81 27 Mar 04**	**903.37 16 May 90**	**888.08 14 Sep 88**

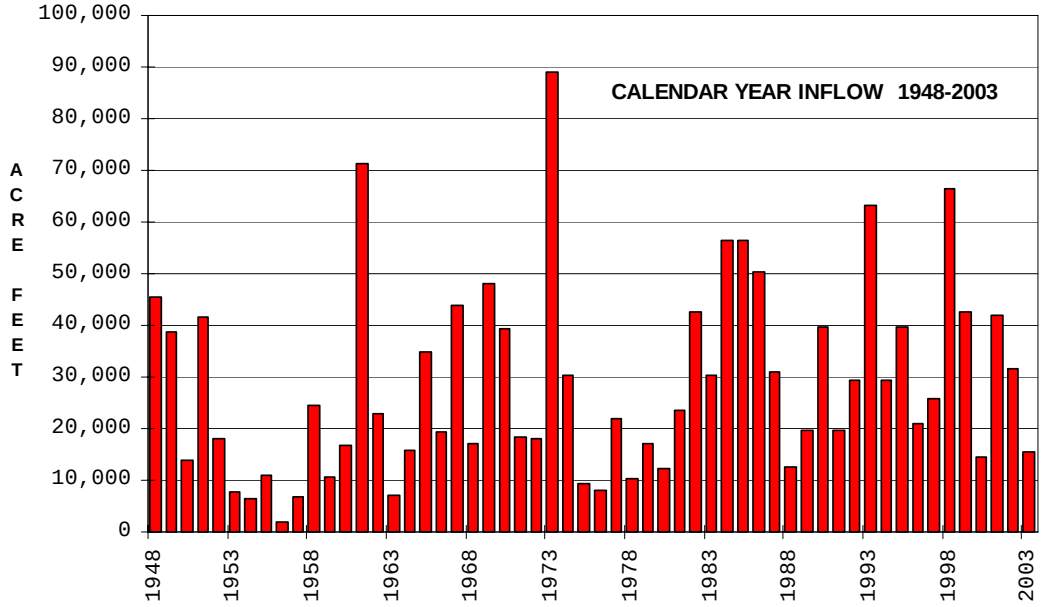
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
3,300 5 Mar 04	**34,352**	**1,032 5 Mar 04**	**8 Many days**

Listed outflows are total to the river from the gate and the uncontrolled notch. Minimum required release is 8 cfs.

LONGVIEW LAKE MONTHLY INFLOW

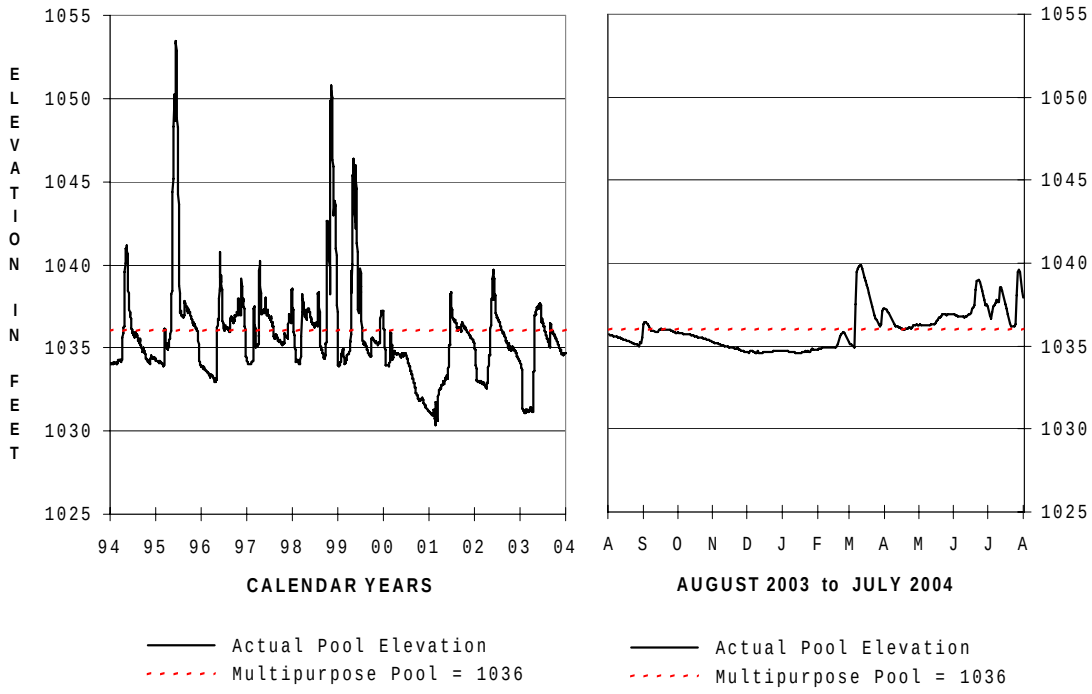


LONGVIEW LAKE ANNUAL INFLOW



MELVERN LAKE
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

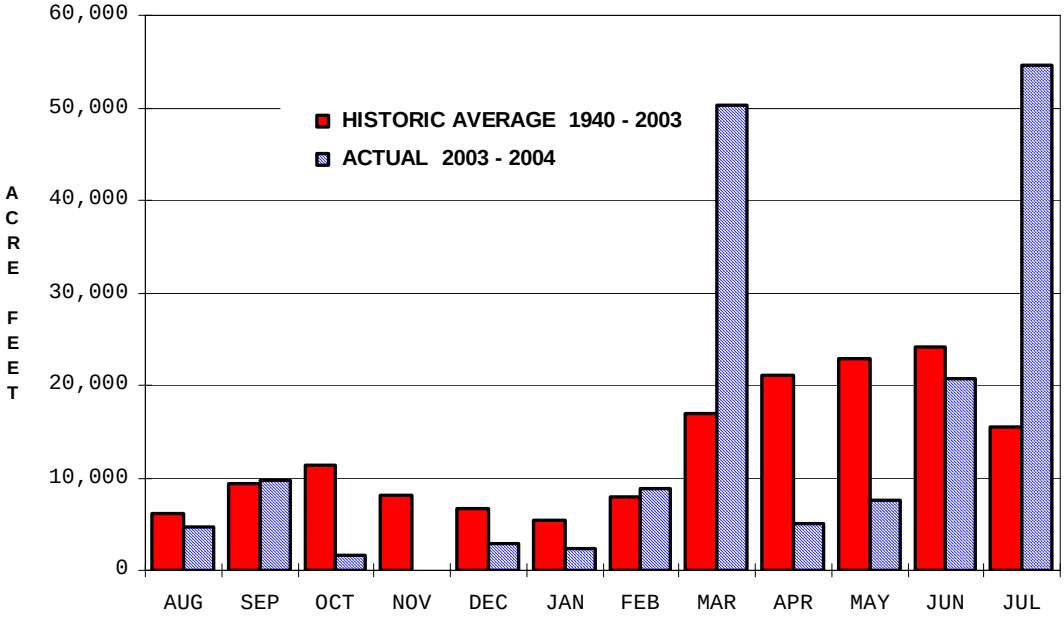


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1035.71 1 Aug 03	**1037.92 31 Jul 04**	**1039.25 9 Mar 04**	**1034.57 16 Jan 04**	**1053.45 13 Jun 95**	**1029.87 11 Feb 92**

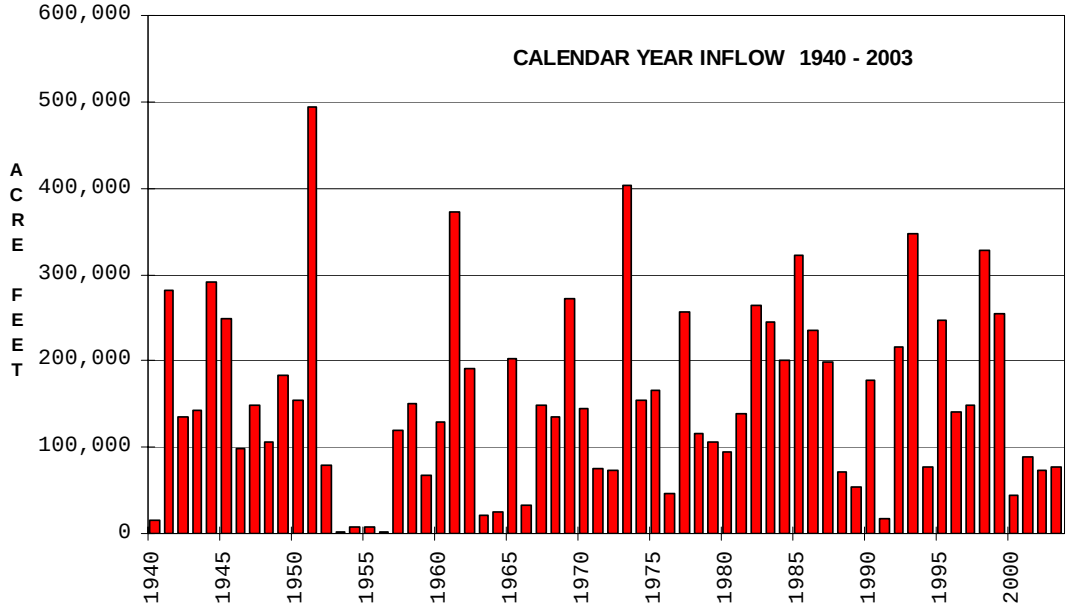
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
9,300 5 Mar 04	**168,262**	**2,000 30 Jul 04**	**20 Many Days**

Minimum required release is 20 cfs.

MELVERN LAKE MONTHLY INFLOW

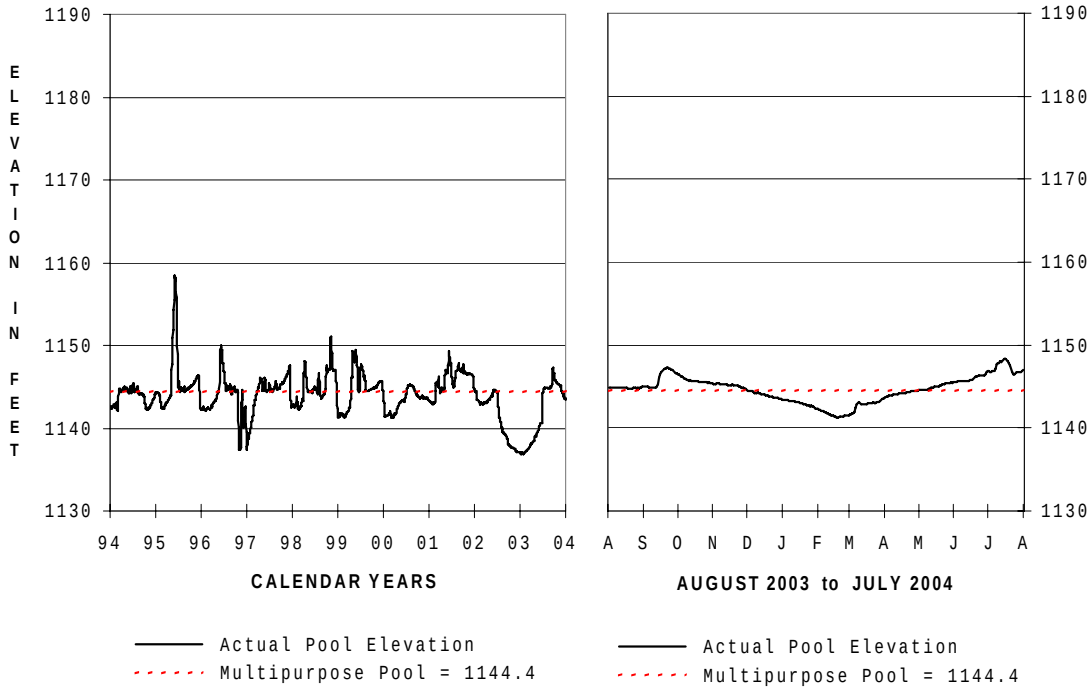


MELVERN LAKE ANNUAL INFLOW



MILFORD LAKE
2003 - 2004 REGULATION

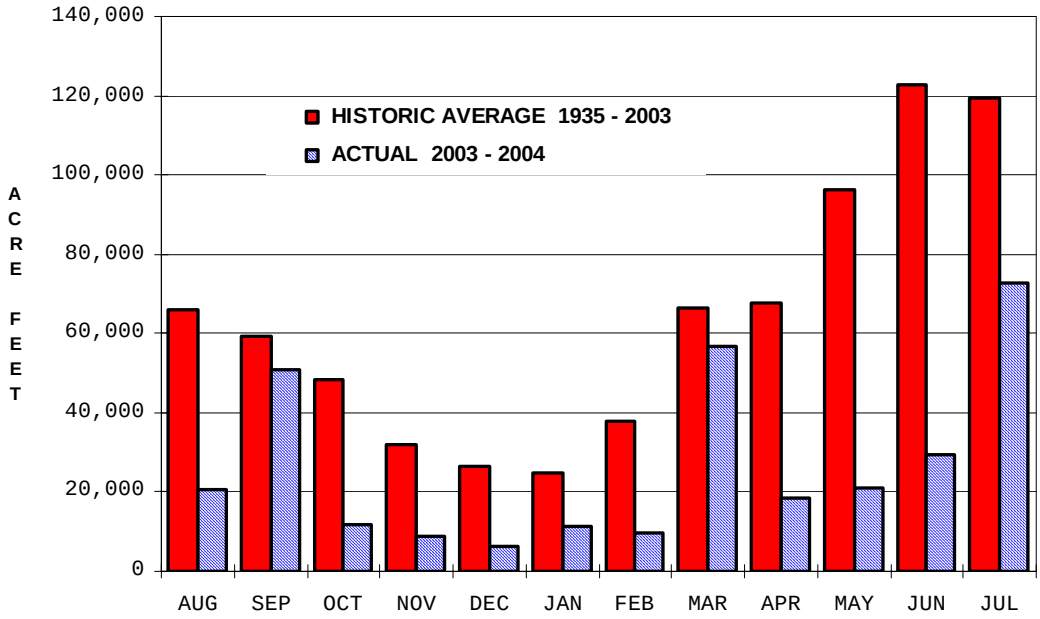
A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



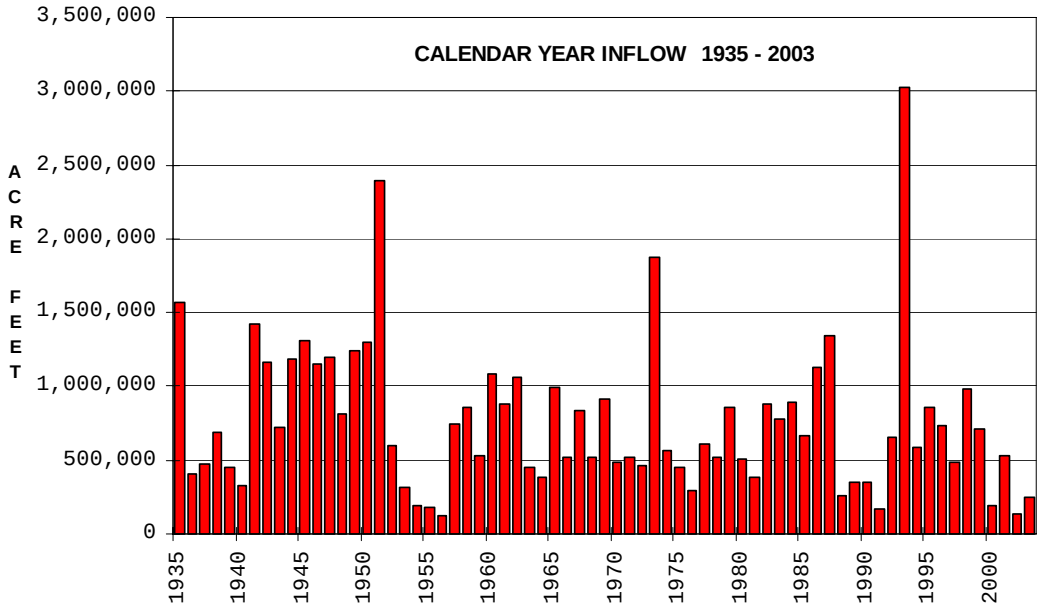
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1144.87 1 Aug 03	**1147.00 31 Jul 04**	**1148.34 15 Jul 04**	**1141.30 19 Feb 04**	**1181.94 25 Jul 93**	**1136.89 13 Jan 03**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
5,800 14 Sep 03	**318,805**	**3,200 21 Jul 04**	**25 Many Days**
Minimum required release is 25 cfs.			

MILFORD LAKE MONTHLY INFLOW

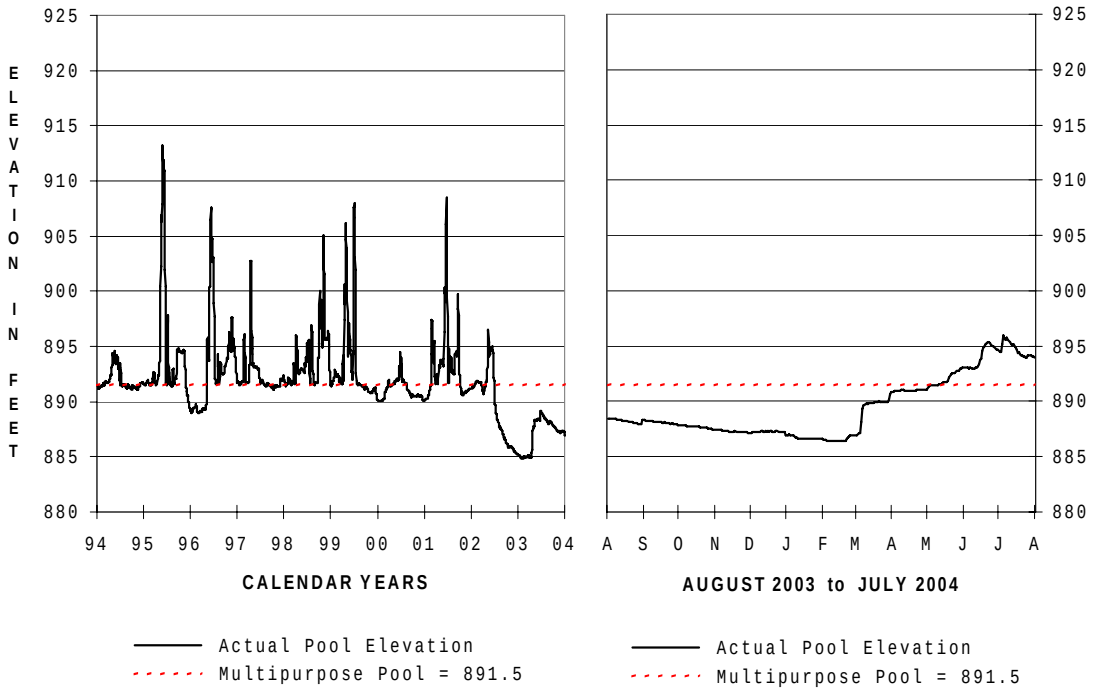


MILFORD LAKE ANNUAL INFLOW



PERRY LAKE
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

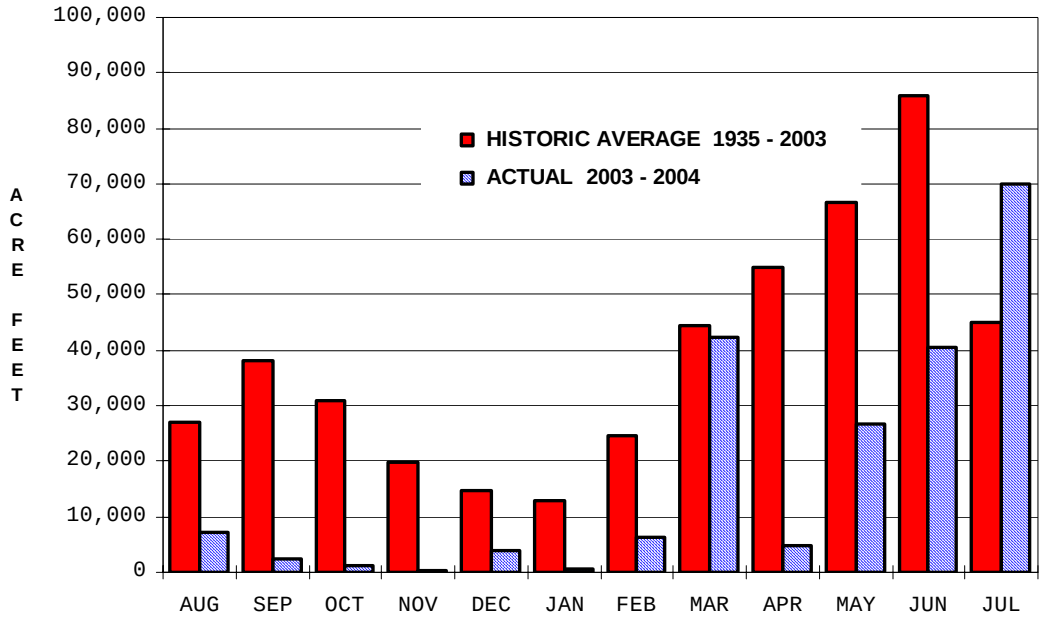


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
888.45 1 Aug 03	**893.99 31 Jul 04**	**895.94 4 Jul 04**	**886.39 19 Feb 04**	**920.85 25 Jul 93**	**884.79 30 Jan 03**

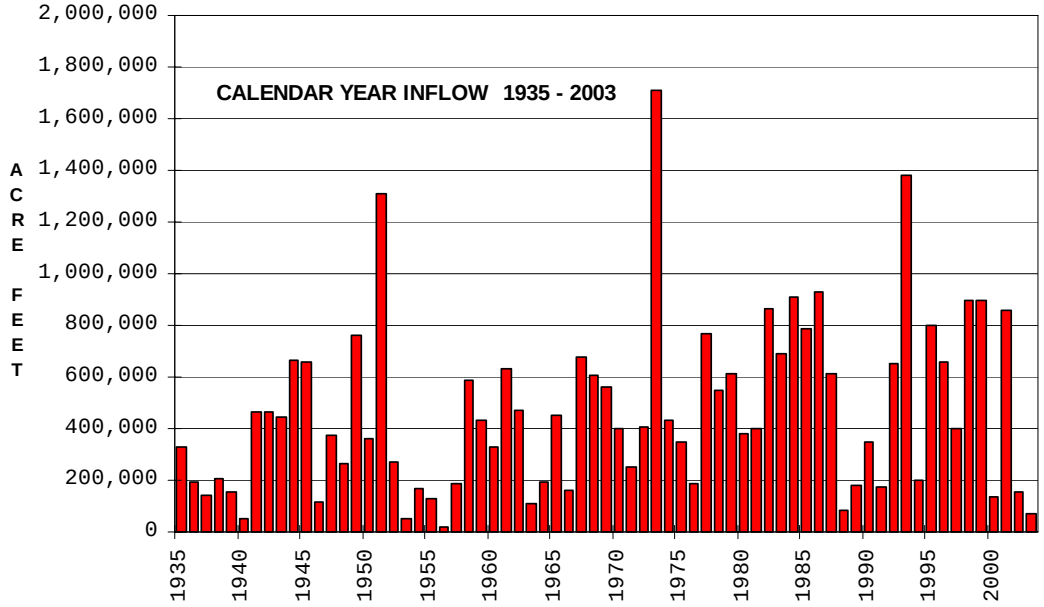
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
7,500 4 Jul 04	**206,369**	**3,000 7 Jul 04**	**0 23 Apr 04**

All outflows are to the river. Minimum required release is 25 cfs. Releases cut to 0 for short maintenance periods.

PERRY LAKE MONTHLY INFLOW

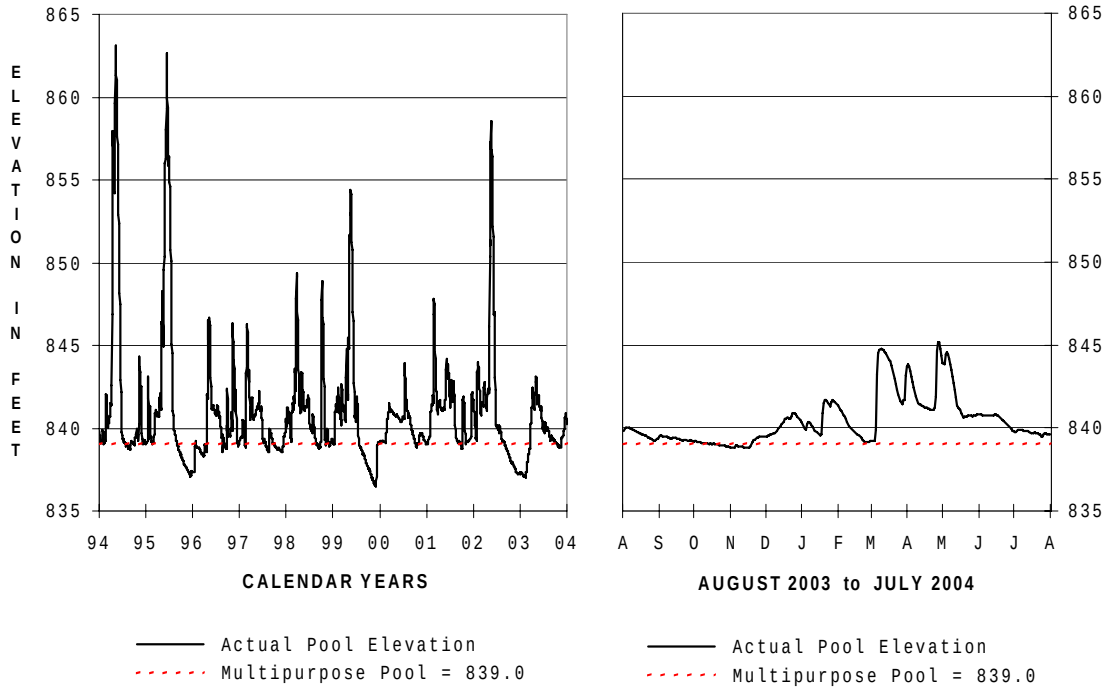


PERRY LAKE ANNUAL INFLOW



POMME DE TERRE LAKE
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

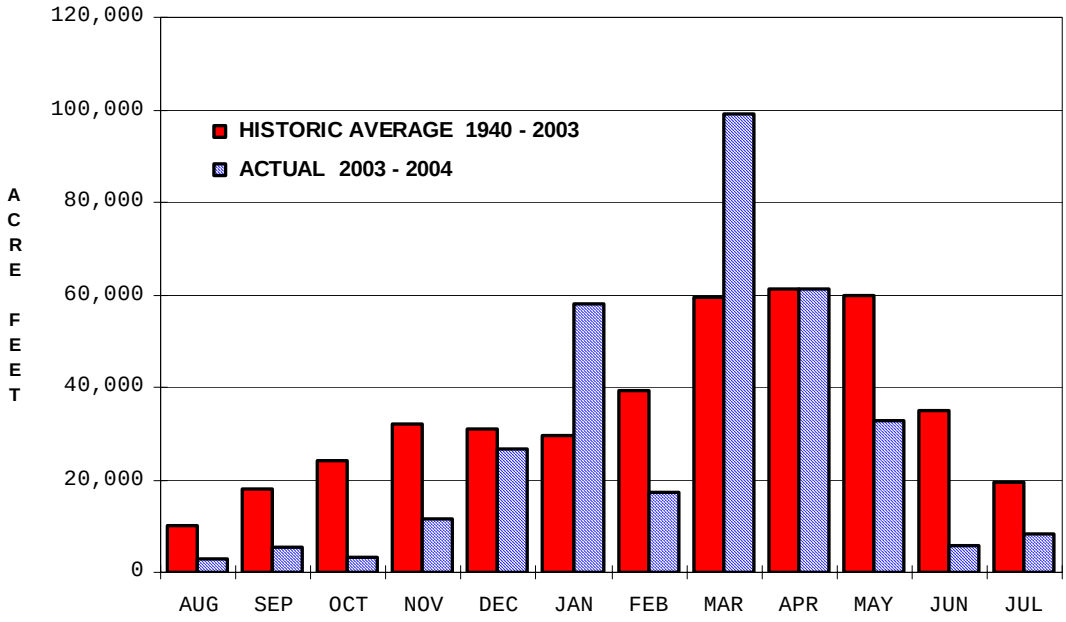


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
839.84 1 Aug 03	**839.60 31 Jul 04**	**845.17 26 Apr 04**	**838.80 1 Nov 03**	**864.58 27 Sep 93**	**835.61 3 Mar 64**

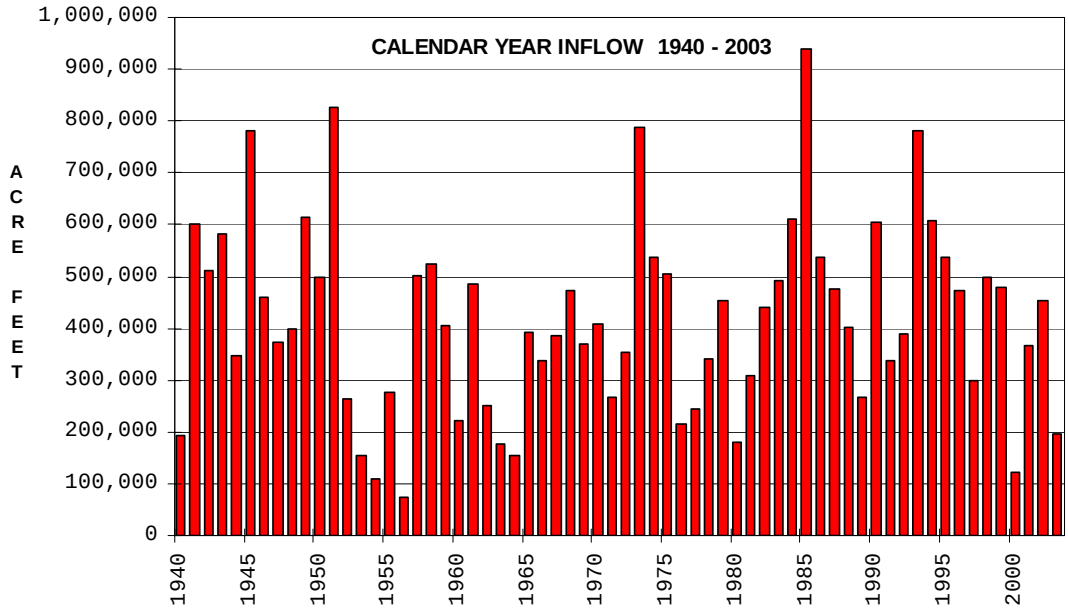
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
14,400 5 Mar 04	**331,798**	**2,500 29 Apr 04**	**50 Many days**

Minimum required release is 50 to 100 cfs, varying by season and pool level.

POMME DE TERRE LAKE MONTHLY INFLOW

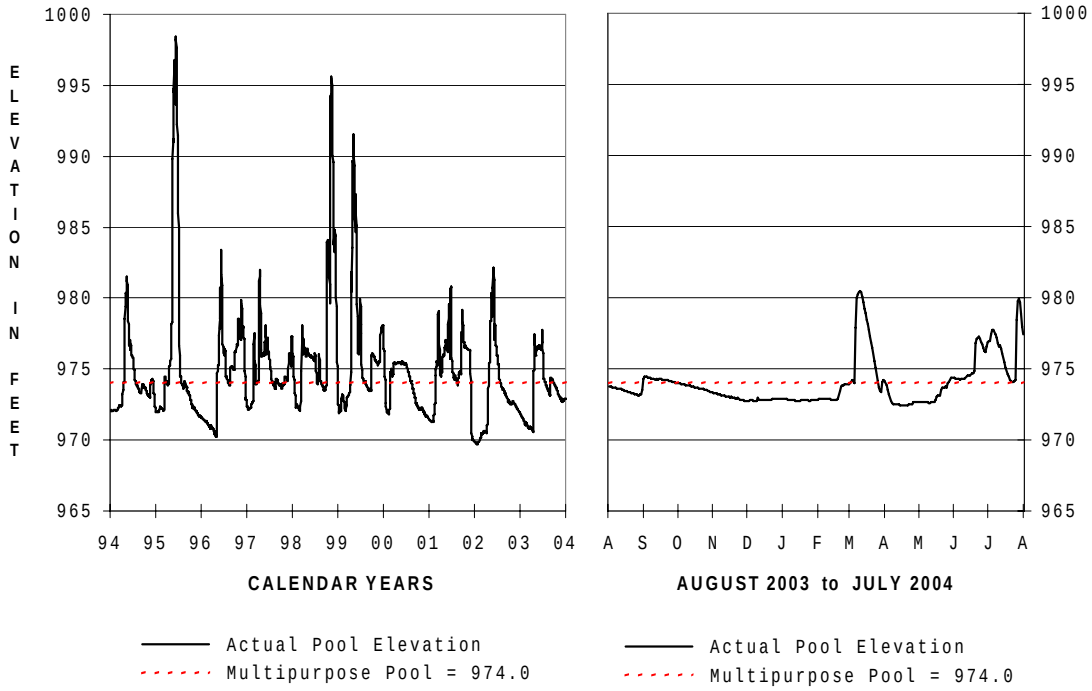


POMME DE TERRE LAKE ANNUAL INFLOW



POMONA LAKE
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

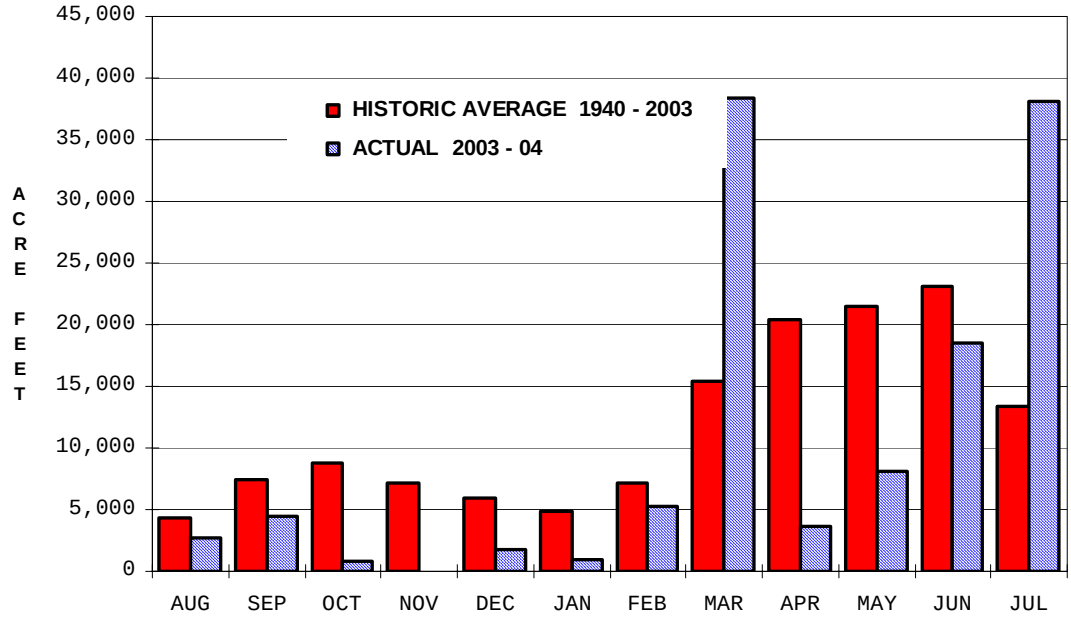


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
973.78 1 Aug 03	**977.45 31 Jul 04**	**980.46 9 Mar 04**	**972.41 16 Apr 04**	**998.40 12-13 Jun 95**	**969.62 30 Mar 67**

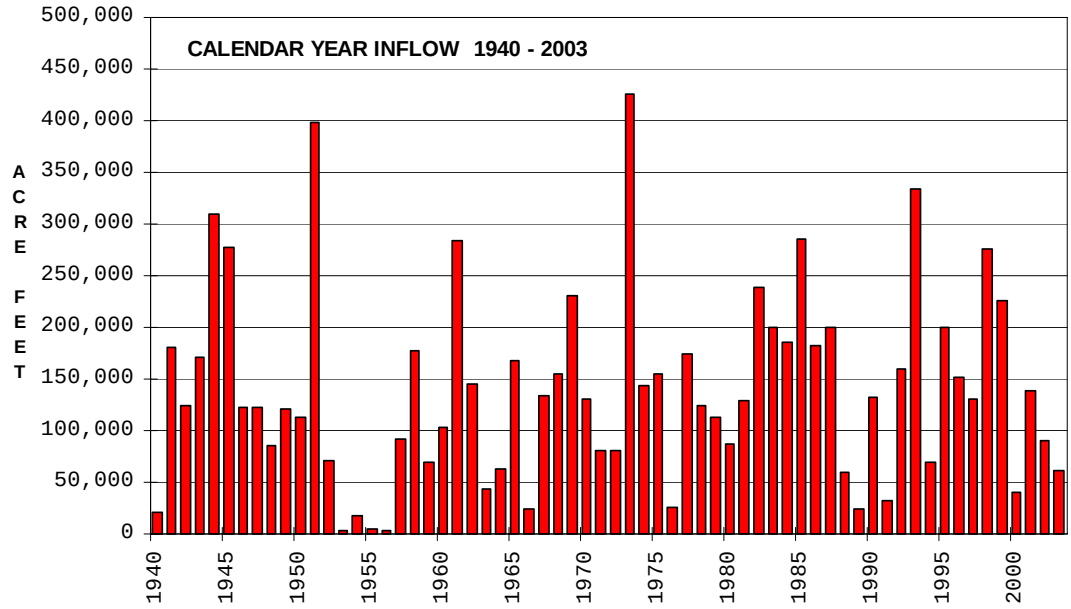
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
9,000 25 Jul 04	**122,822**	**2,000 30 Jul 04**	**15 Many Days**

Minimum required release is 15 cfs.

POMONA LAKE MONTHLY INFLOW

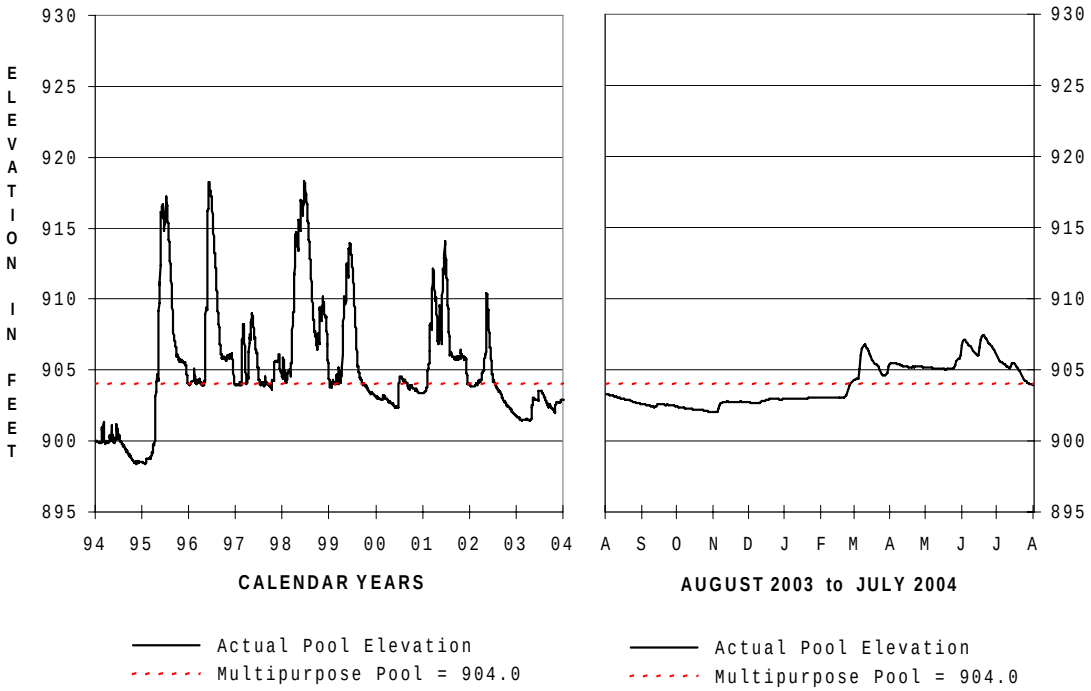


POMOMA LAKE ANNUAL INFLOW



RATHBUN LAKE
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

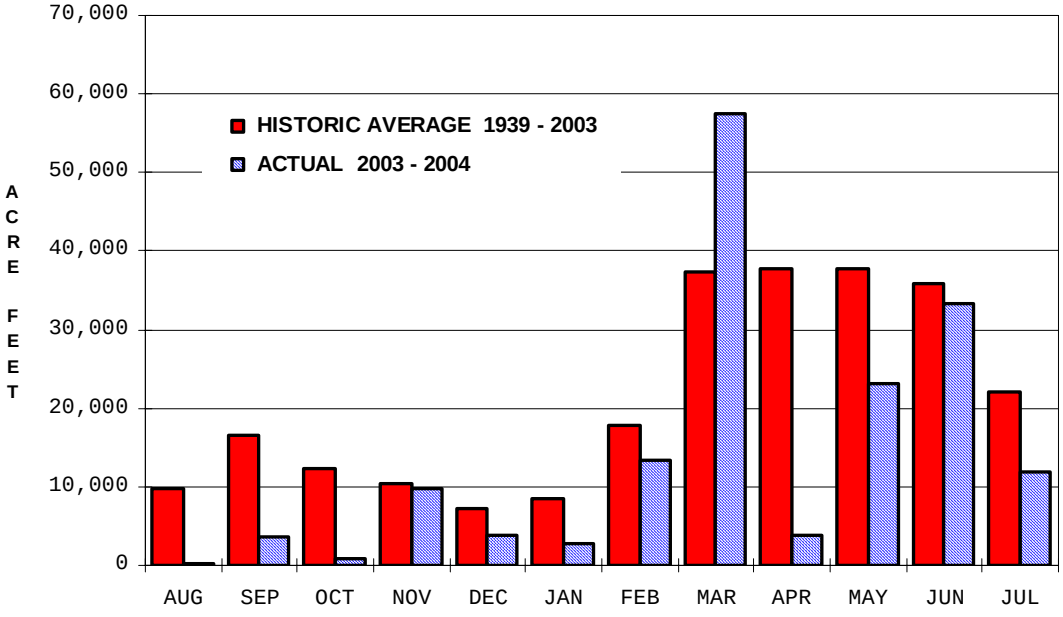


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
903.28 1 Aug 03	**903.24 31 Jul 04**	**907.41 18 Jun 04**	**902.00 2 Nov 03**	**927.16 28 Jul 93**	**898.38 26-27 Jan 95**

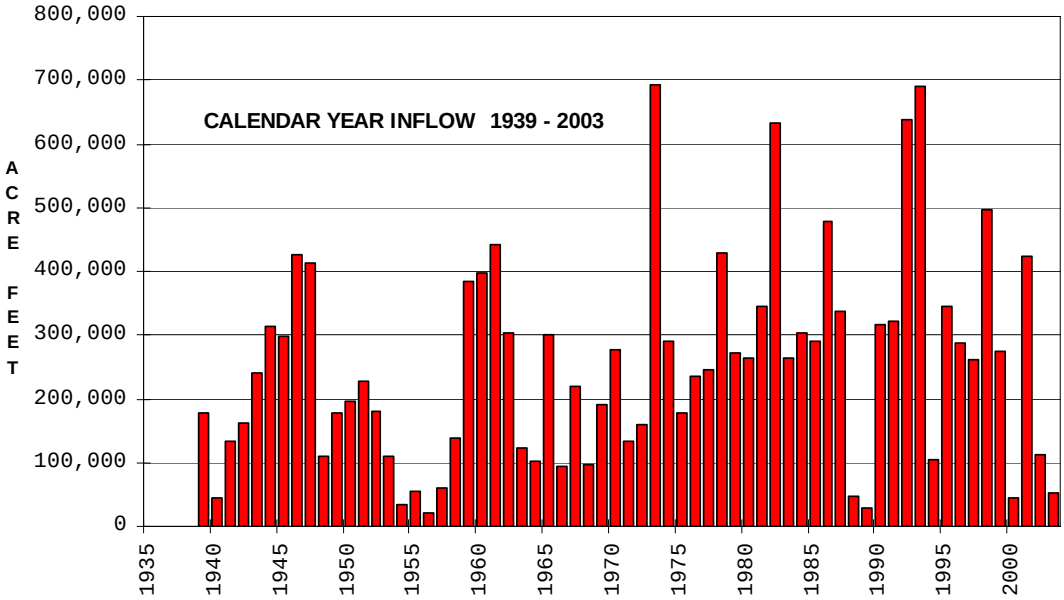
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
6,000 6 Mar 04	**163,414**	**1,200 Many days**	**11 Many days**

Outlets include a fish hatchery pipe and service gate.

RATHBUN LAKE MONTHLY INFLOW

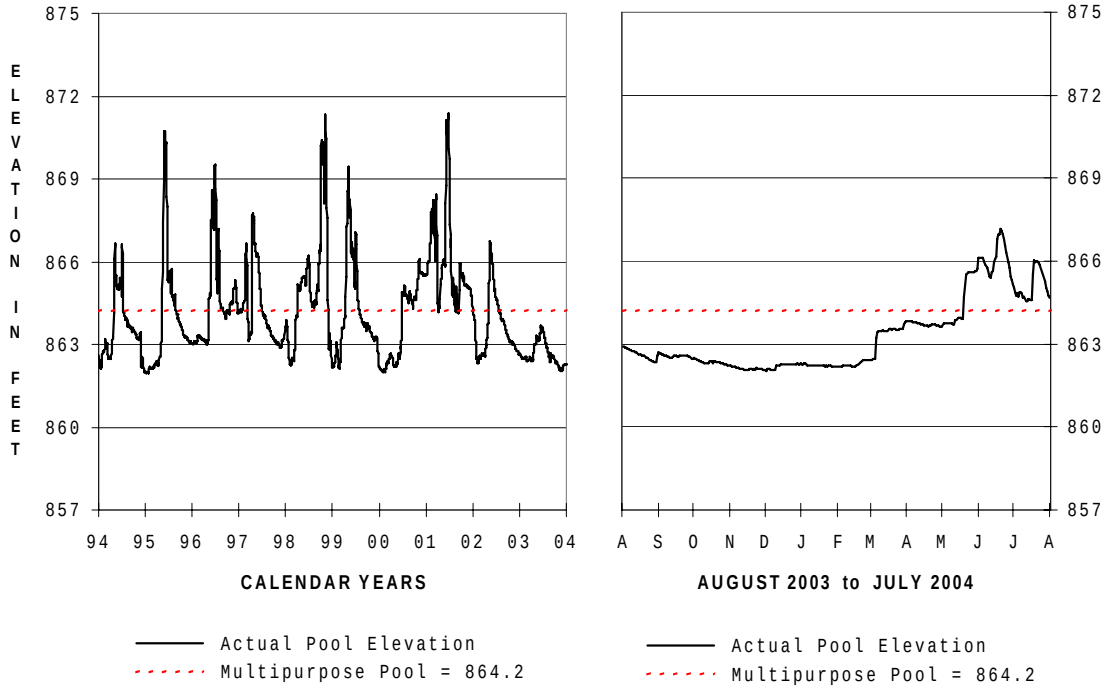


RATHBUN LAKE ANNUAL INFLOW



SMITHVILLE LAKE
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

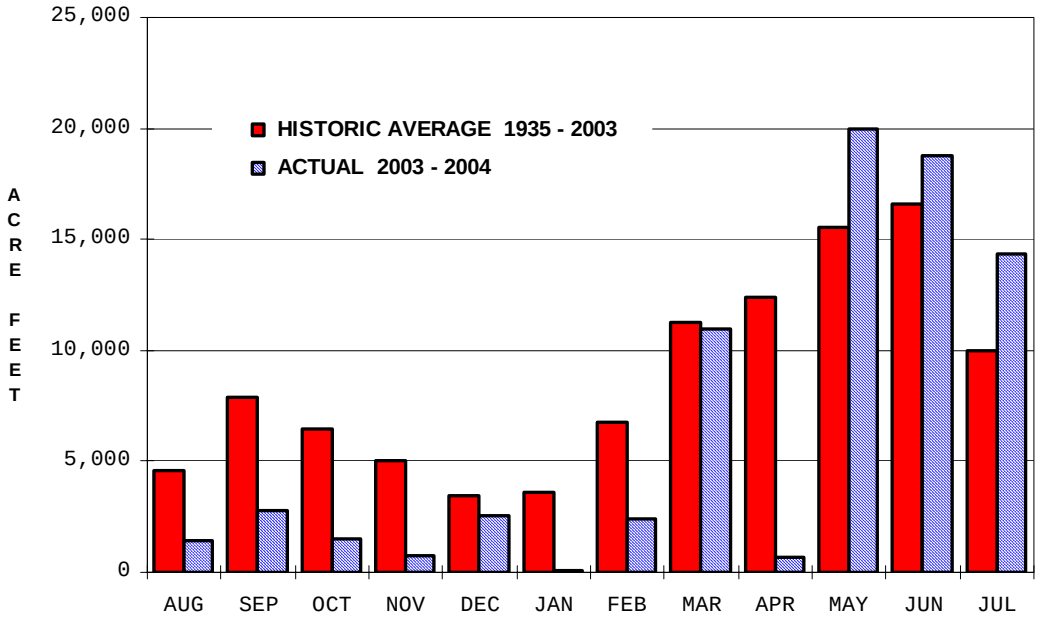


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
862.89 1 Aug 03	**864.68 31 Jul 04**	**867.18 19 Jun 04**	**862.04 2 Dec 03**	**874.31 27-28 Jul 93**	**858.86 19 Jan 93**

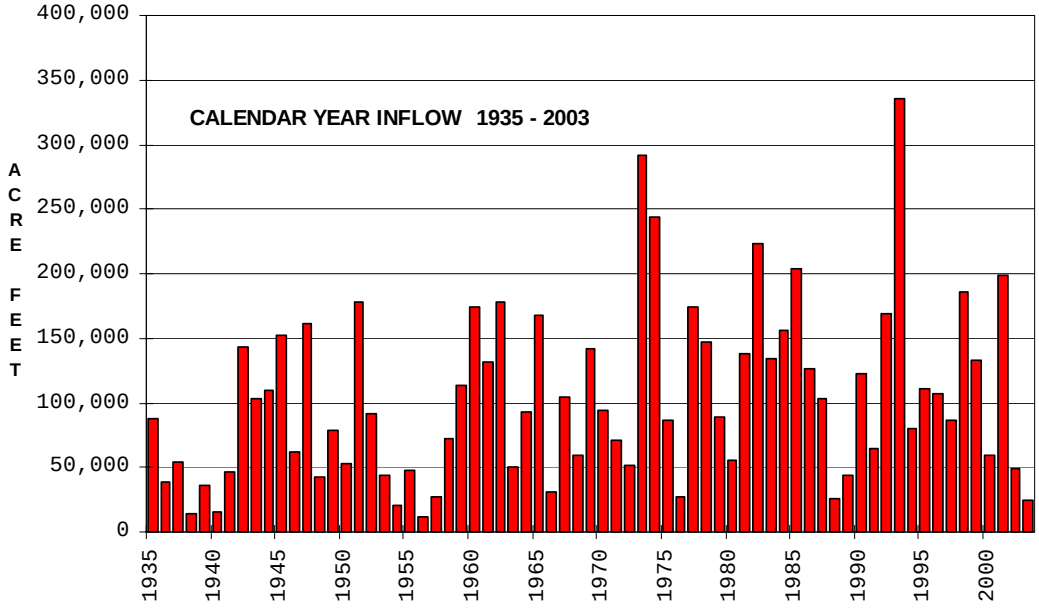
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
3,200 16 Jul 04	**76,120**	**1,000 24 - 27 Jun 04**	**0 11 - 14 Apr 04**

Min required release is 8 cfs. Releases cut to 0 during flooding and for maintenance.

SMITHVILLE LAKE MONTHLY INFLOW

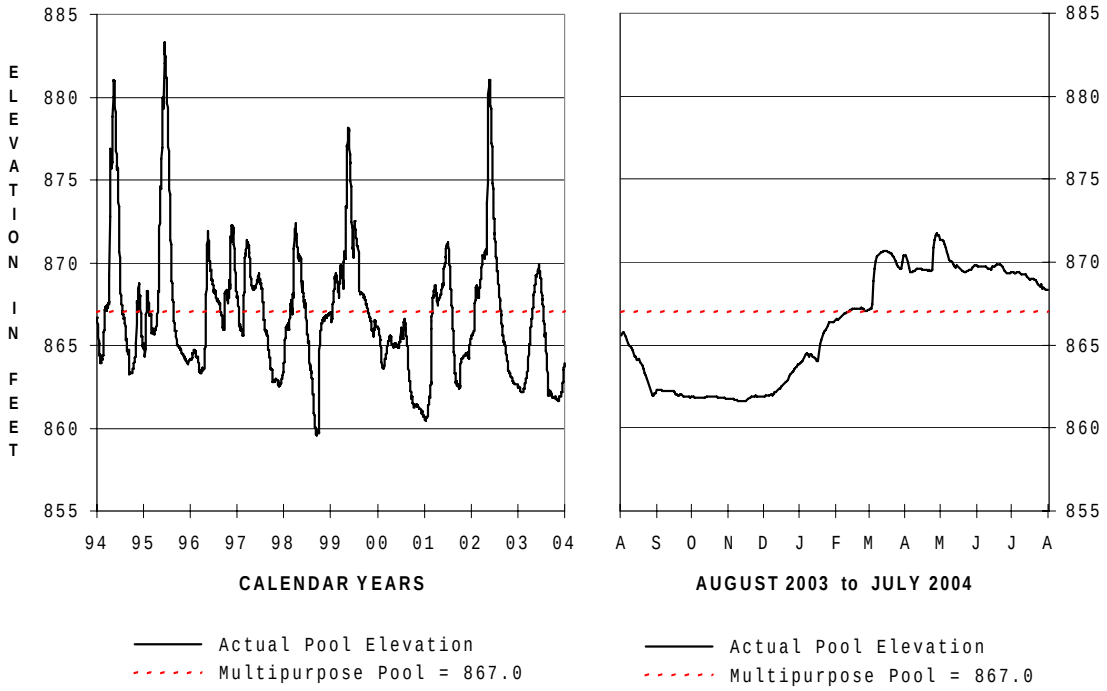


SMITHVILLE LAKE ANNUAL INFLOW



STOCKTON LAKE
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

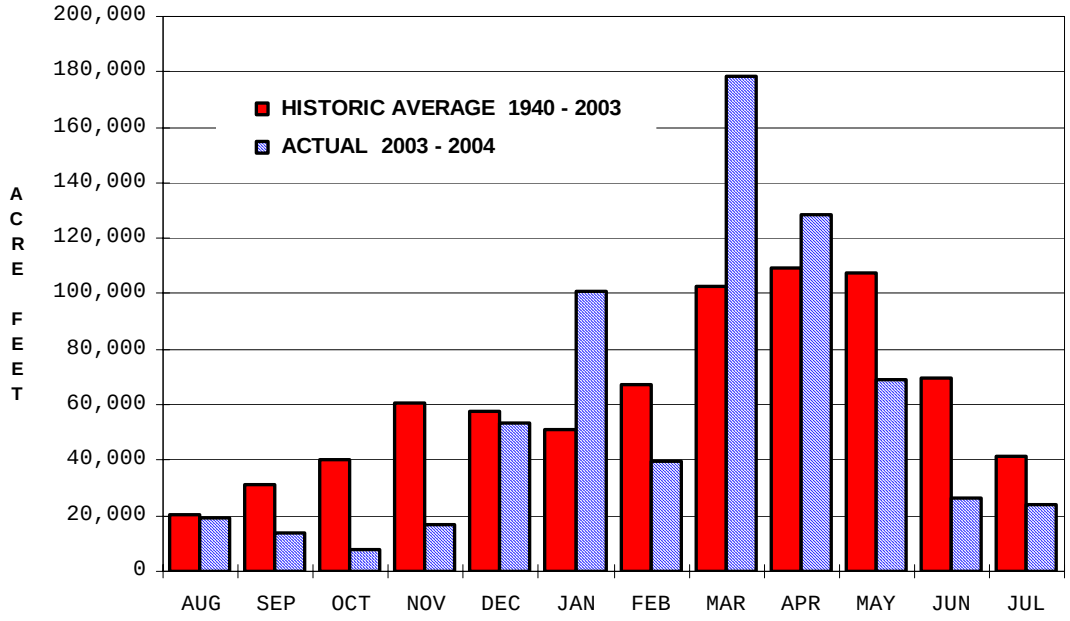


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
865.59 1 Aug 03	**868.35 31 Jul 04**	**871.72 28 Apr 04**	**861.62 17 Nov 03**	**885.94 28 Apr 73**	**851.86 2 Feb 77**

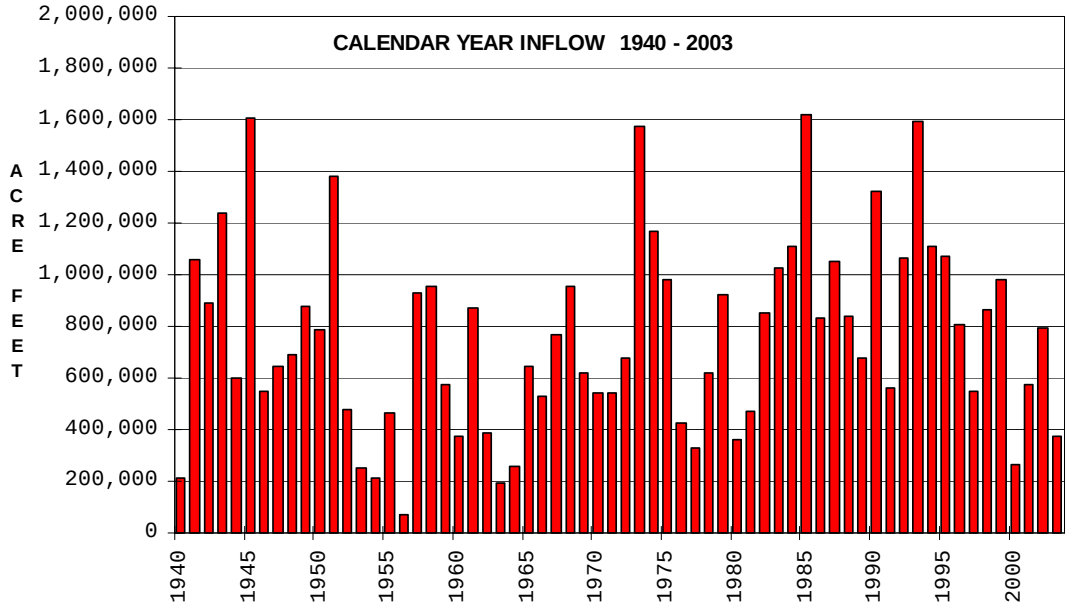
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
18,000 25 Apr 04	**678,385**	**5,440 5 Apr 04**	**40 Many Days**

Listed outflows include turbine releases and spill to the river. Minimum release 40 cfs.

STOCKTON LAKE MONTHLY INFLOW

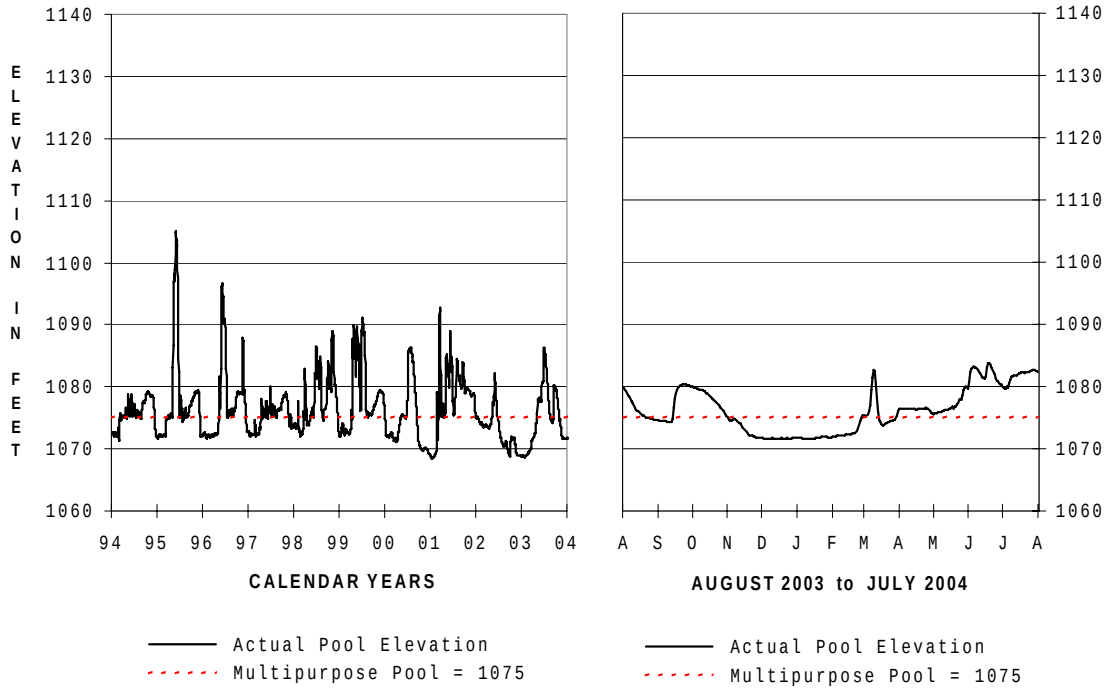


STOCKTON LAKE ANNUAL INFLOW



TUTTLE CREEK LAKE
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

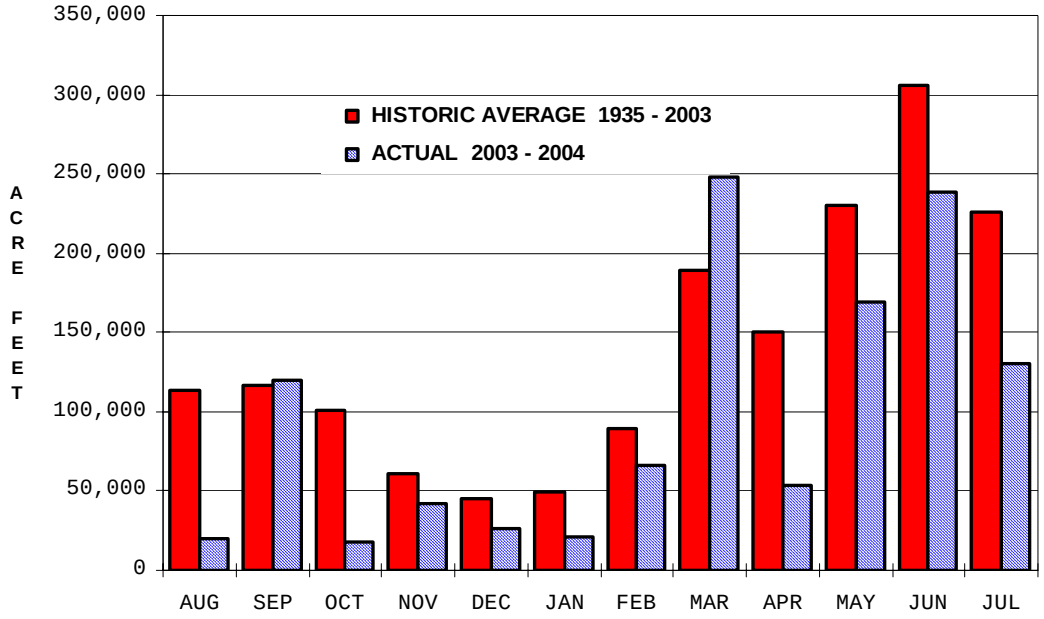


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1079.83 1 Aug 03	**1082.30 31 Jul 04**	**1083.74 10 Jul 04**	**1071.56 11 Jan 04**	**1137.77 22 Jul 93**	**1060.82 4 Jan 67**

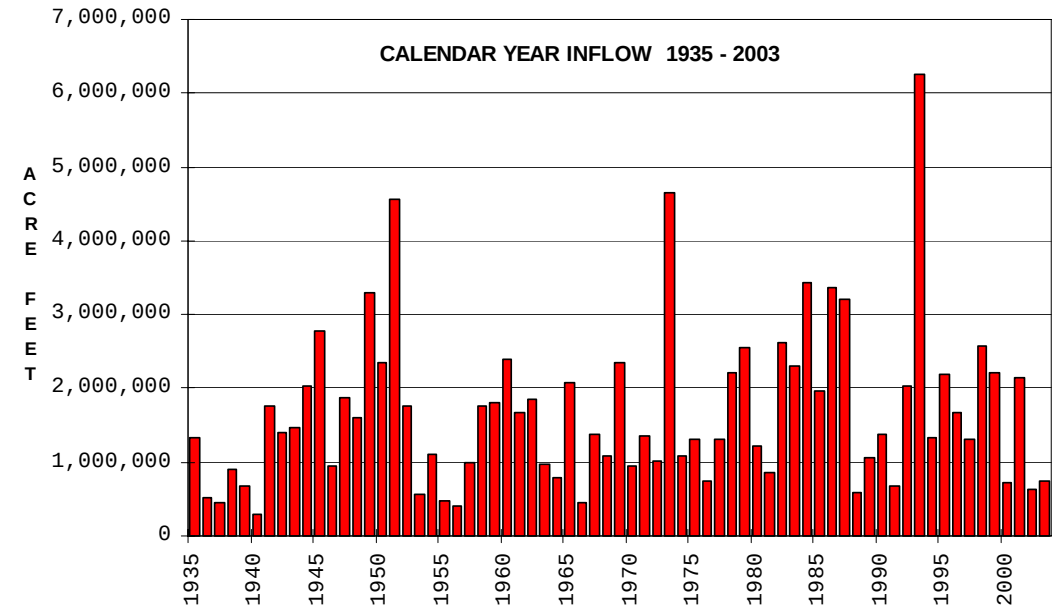
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
22,000 6 Mar 04	**1,154,915**	**20,000 11 Mar 04**	**100 Many days**

All outflows are to the river. Minimum release is 50 to 100 cfs. Releases cut to 0 for short maintenance periods.

TUTTLE CREEK LAKE MONTHLY INFLOW

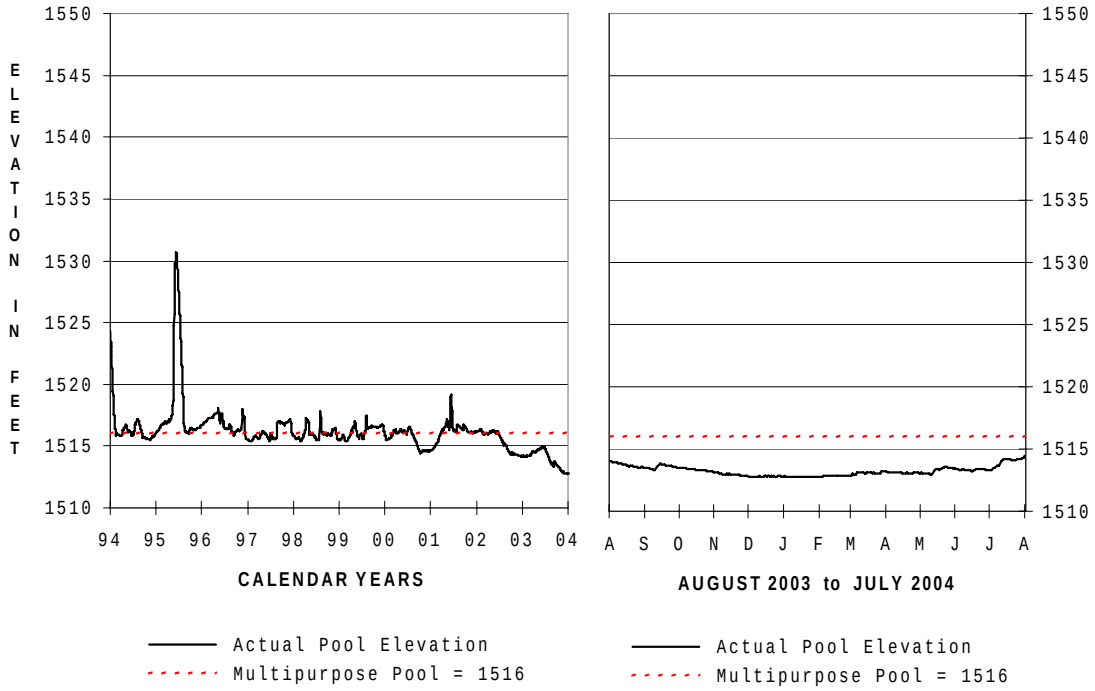


TUTTLE CREEK LAKE ANNUAL INFLOW



WILSON LAKE
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

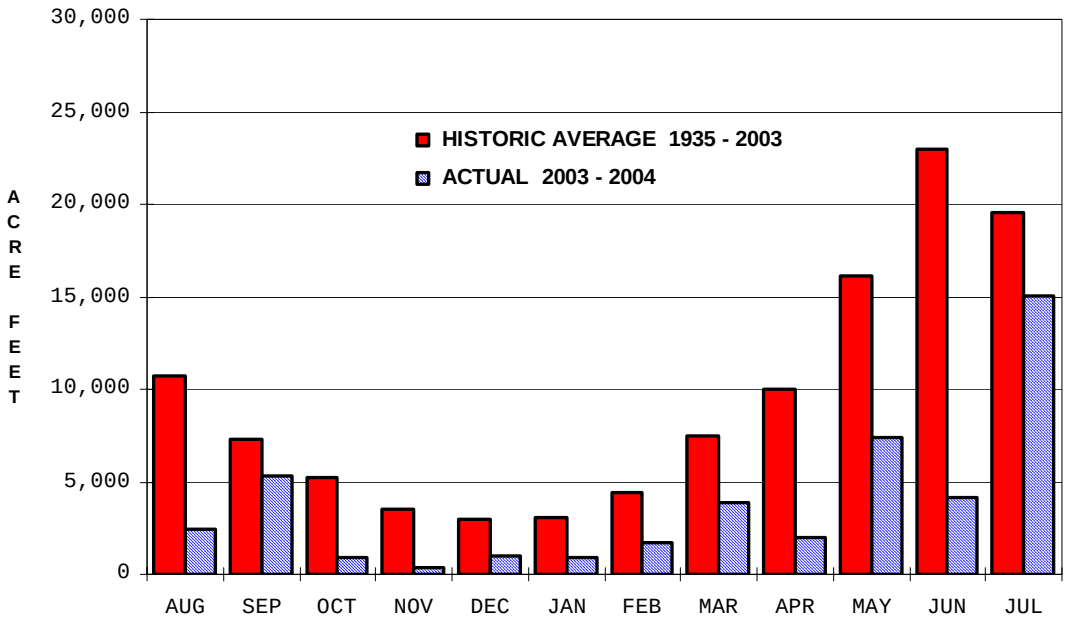


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1514.02 1 Aug 03	**1514.42 31 Jul 04**	**1514.42 31 Jul 04**	**1512.74 9 Jan 04**	**1548.27 13 Aug 93**	**1509.62 27 May 92**

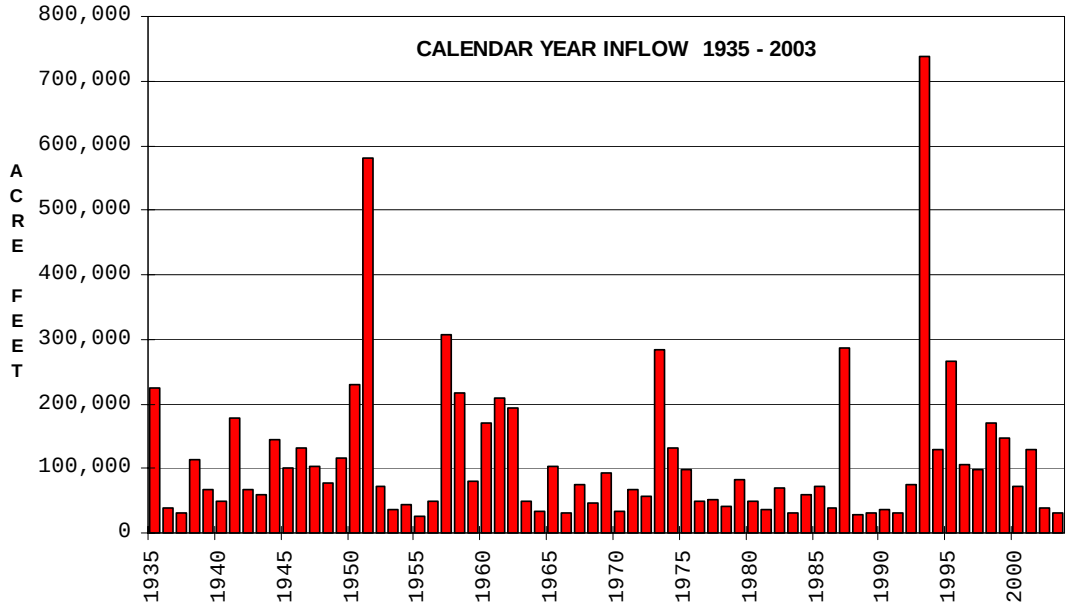
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
900 11 Sep 03	**44,987**	**15 Many days**	**5 Many days**

Minimum required release of 5-15 cfs varies seasonally

WILSON LAKE MONTHLY INFLOW



WILSON LAKE ANNUAL INFLOW



APPENDIX B
BUREAU OF RECLAMATION PROJECTS

BONNY RESERVOIR

CEDAR BLUFF RESERVOIR

ENDERS RESERVOIR

HARRY STRUNK LAKE
(Medicine Creek Dam)

HUGH BUTLER LAKE
(Red Willow Dam)

KEITH SEBELIUS LAKE
(Norton Dam)

KIRWIN RESERVOIR

LOVEWELL RESERVOIR

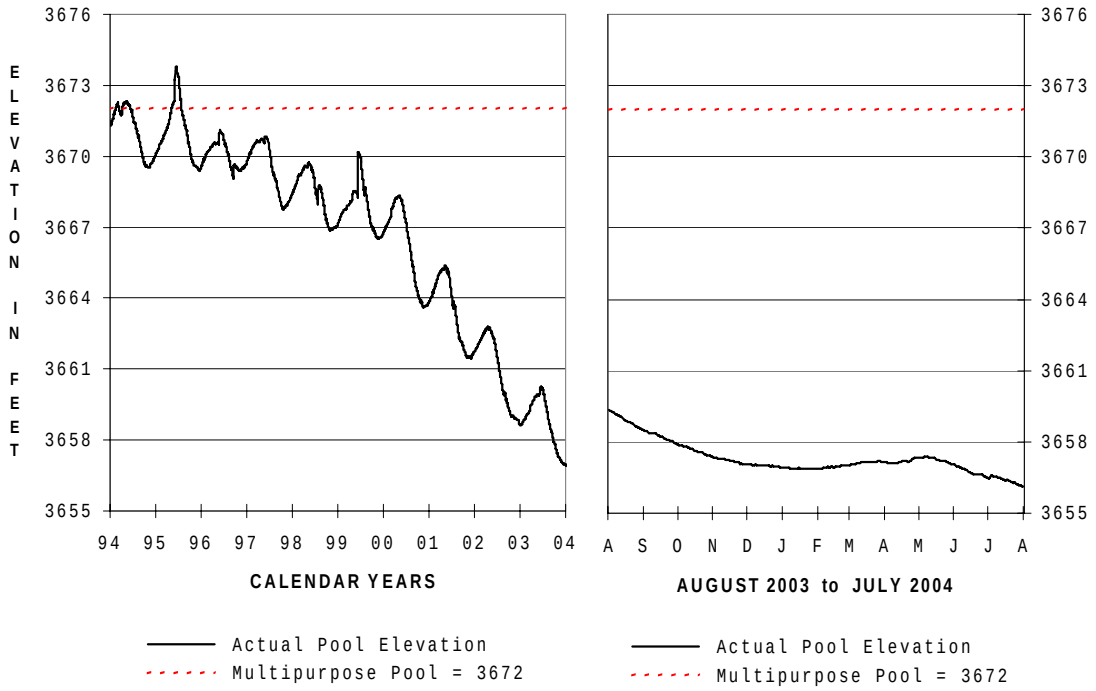
SWANSON LAKE
(Trenton Dam)

WACONDA LAKE
(Glen Elder Dam)

WEBSTER RESERVOIR

BONNY RESERVOIR
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



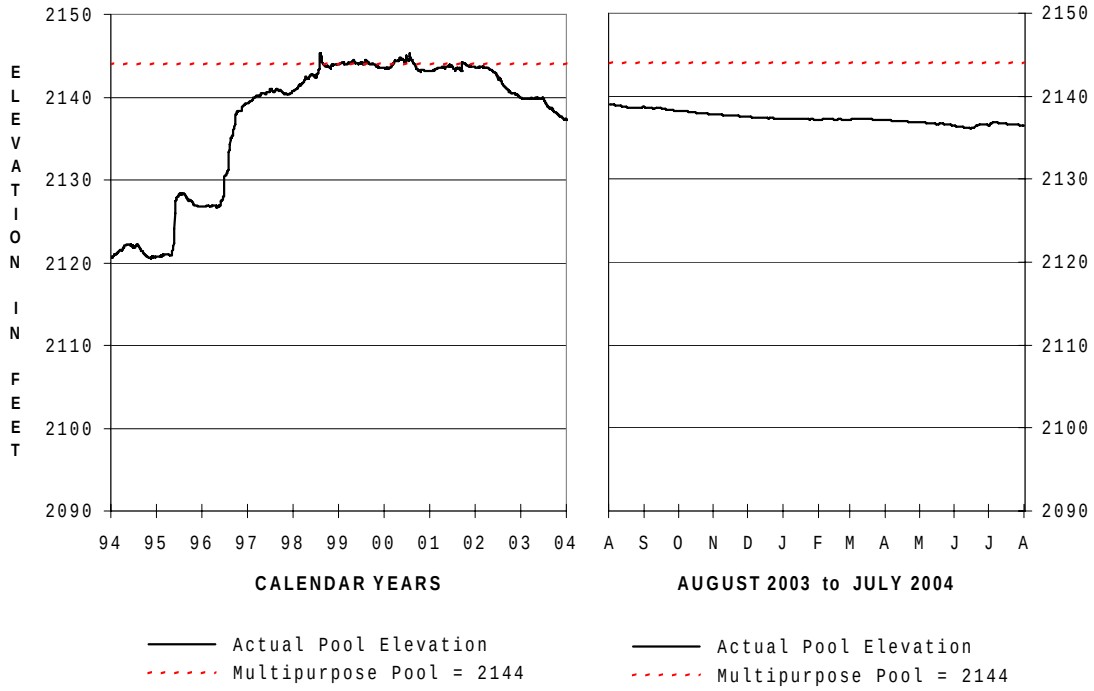
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
3659.35 1 Aug 03	**3656.11 31 Jul 04**	**3659.35 1 Aug 03**	**3656.11 2 Jan 04**	**3678.10 17 May 57**	**3656.11 31 Jul 04**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
60 22 Apr 04	**4,750**	**7 Many days**	**6 Most days**

Max daily outflow is river release only.

CEDAR BLUFF RESERVOIR
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



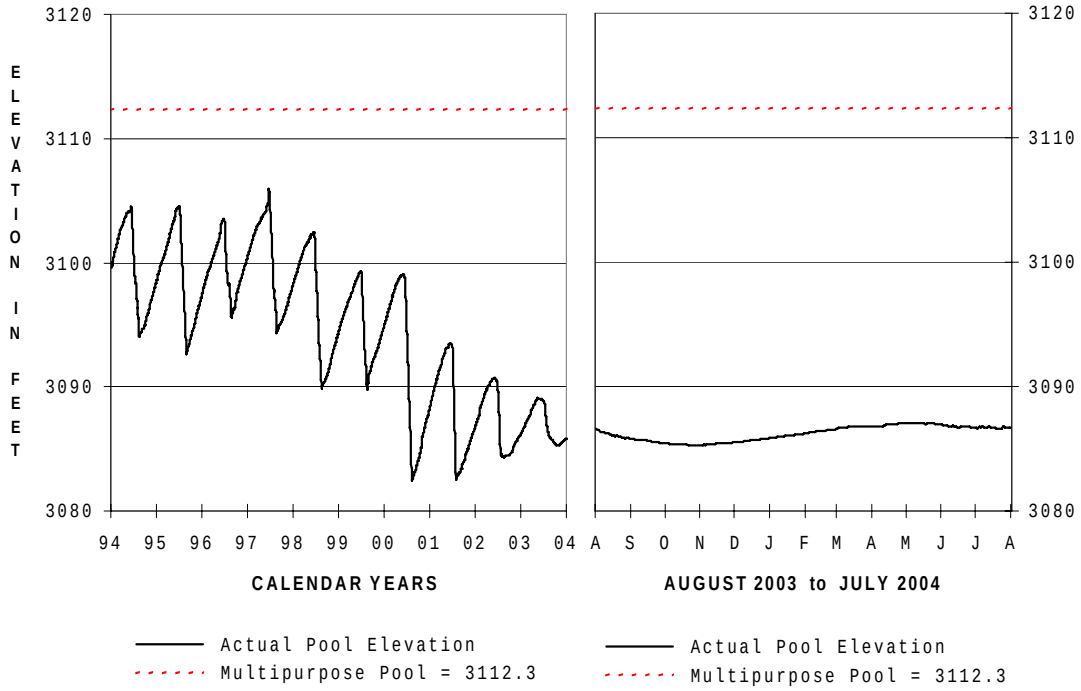
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2139.03 1 Aug 03	**2136.52 31 Jul 04**	**2139.03 1 Aug 03**	**2136.13 14 Jun 04**	**2154.90, 2 Jul 51 4-5 Jul 57**	**2091.78 9-19 Nov 92**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
400 1 Jul 04	**11,575**	**0 All days**	**0 All days**

No required min release. Minor releases to fish hatchery.

ENDERS RESERVOIR
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



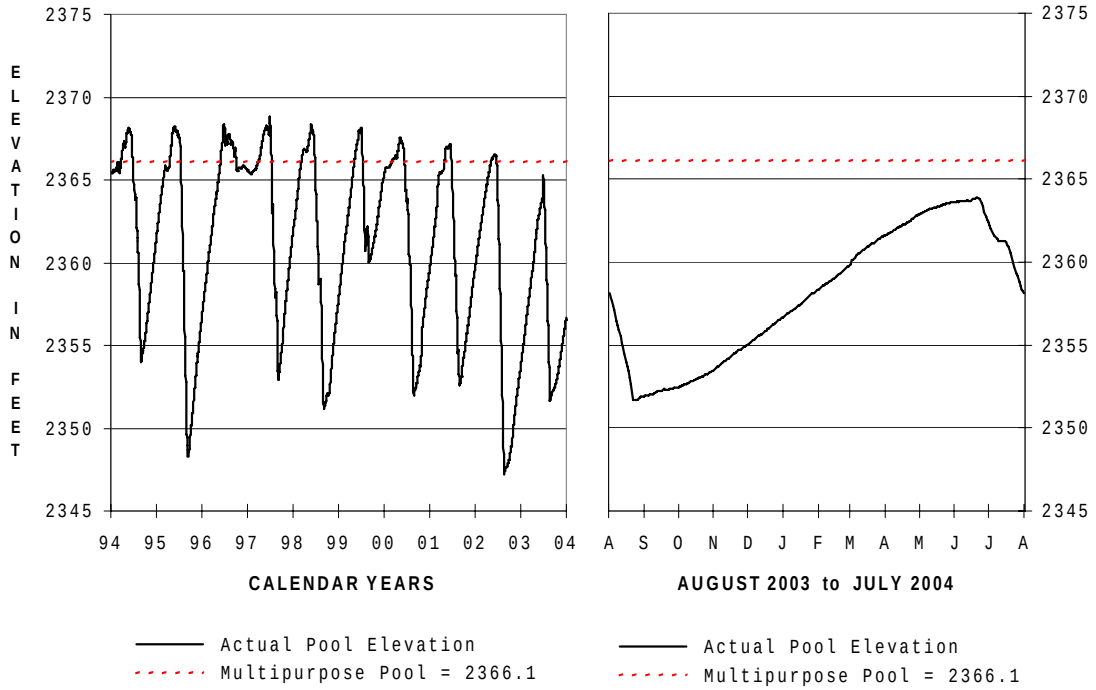
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
3086.64 1 Aug 03	**3086.72 31 Jul 04**	**3087.07 1 May 04**	**3085.27 1 Nov 03**	**3118.20 25 Mar 60**	**3080.67 28 Aug 78**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
50 1 Mar 04	**5,090**	**30 1 Aug 03**	**1 Most days**

Max daily outflow occurred as part of normal irrigation releases. All releases to the river. No required min release.

HARRY STRUNK LAKE
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



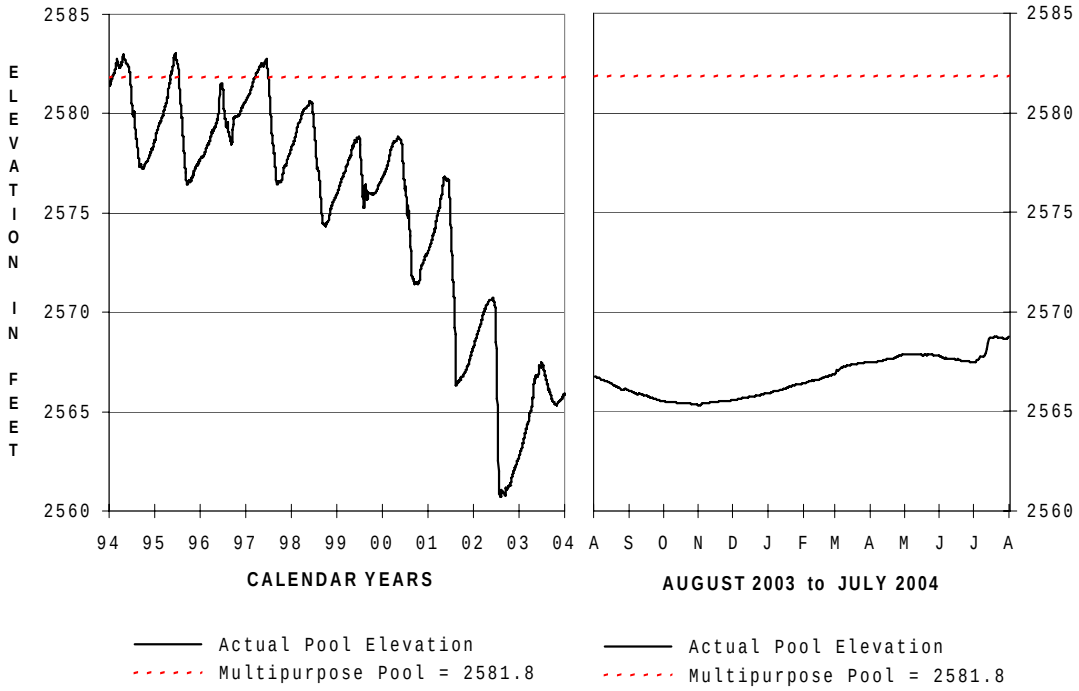
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2358.11 1 Aug 03	**2358.15 31 Jul 04**	**2363.91 20 Jun 04**	**2351.67 23 Aug 03**	**2374.10 23 Mar 60**	**2340.42 8 Sep 78**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
180 1 Mar 04	**26,710**	**300 22 Aug 03**	**1 Most days**

Max daily outflow occurred as part of normal irrigation releases. All releases to the river.

HUGH BUTLER LAKE
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

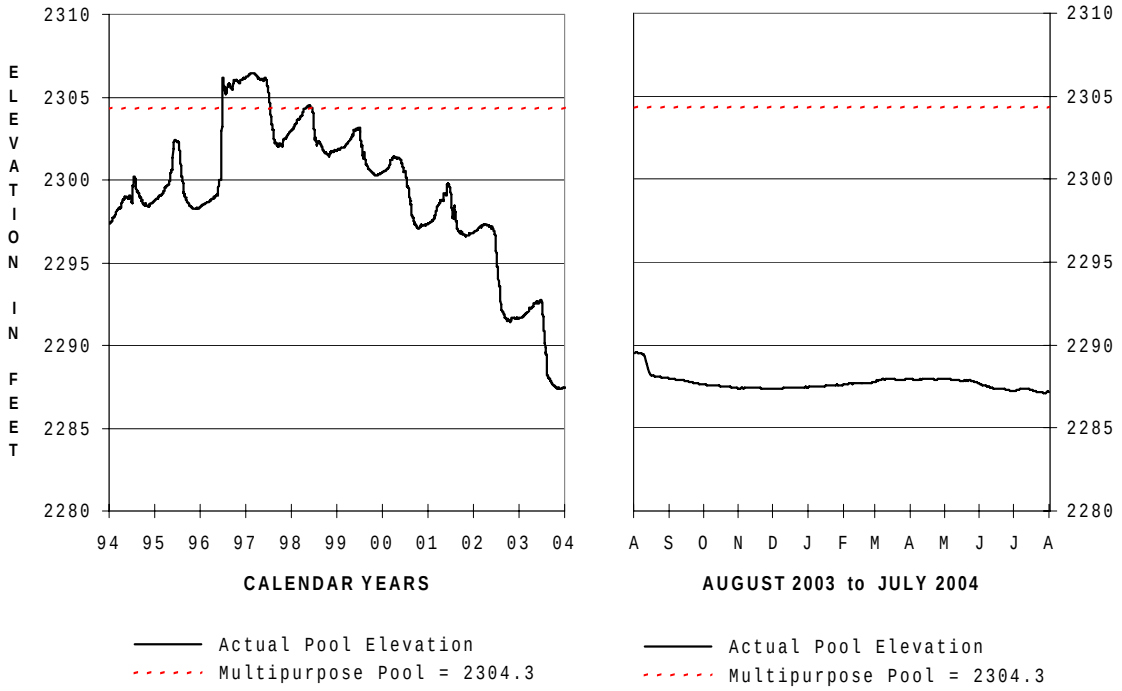


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2566.76 1 Aug 03	**2568.74 31 Jul 04**	**2568.78 18 Jul 04**	**2565.30 1 Nov 03**	**2584.11 16 Jul 67**	**2560.72 8 Aug 02**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
140 12 Jul 04	**9,120**	**4 All days**	**4 All days**

KEITH SEBELIUS LAKE
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD E XPANDED FOR READING EASE.



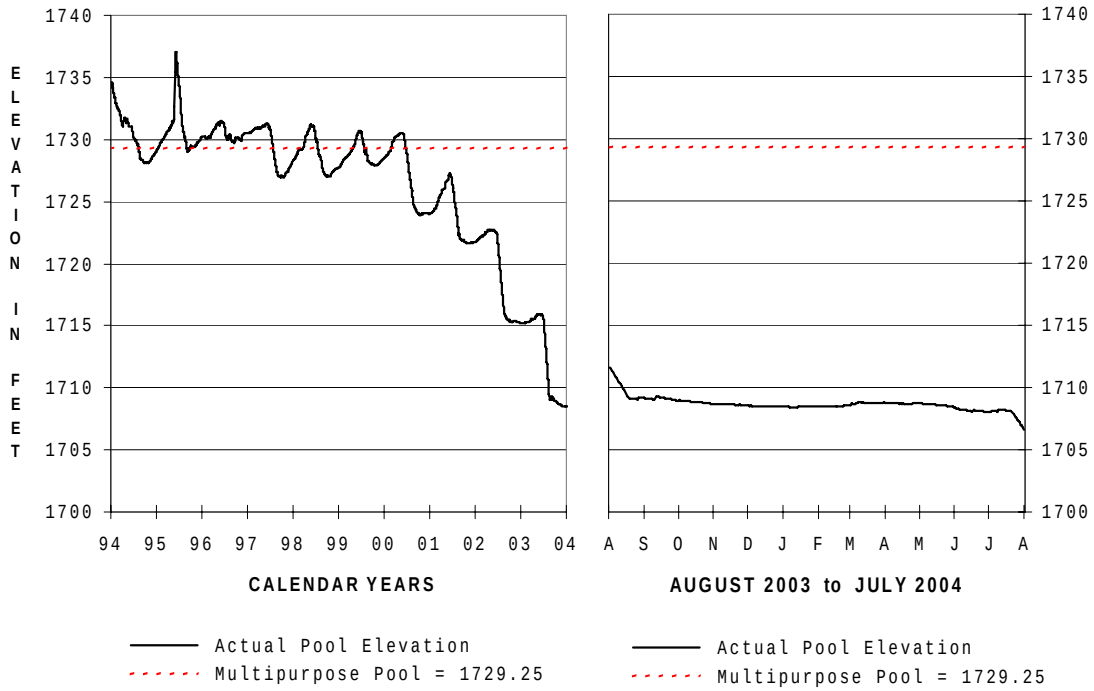
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2289.54 1 Aug 03	**2287.17 31 Jul 04**	**2289.57 2 Aug 03**	**2287.09 28 Jul 04**	**2306.47 15 Feb to 4 Mar 97**	**2275.82 1 Feb 82**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
50 6 Jul 04	**4,000**	**110 11 Aug 03**	**1 Most days**

Max daily outflow occurred as part of normal irrigation releases. No required min release.
Historic Minimum Pool Elevation of 2275.82 occurred on many days 28-29 Nov 81 and 20 Jan to 1 Feb 82.

KIRWIN RESERVOIR
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



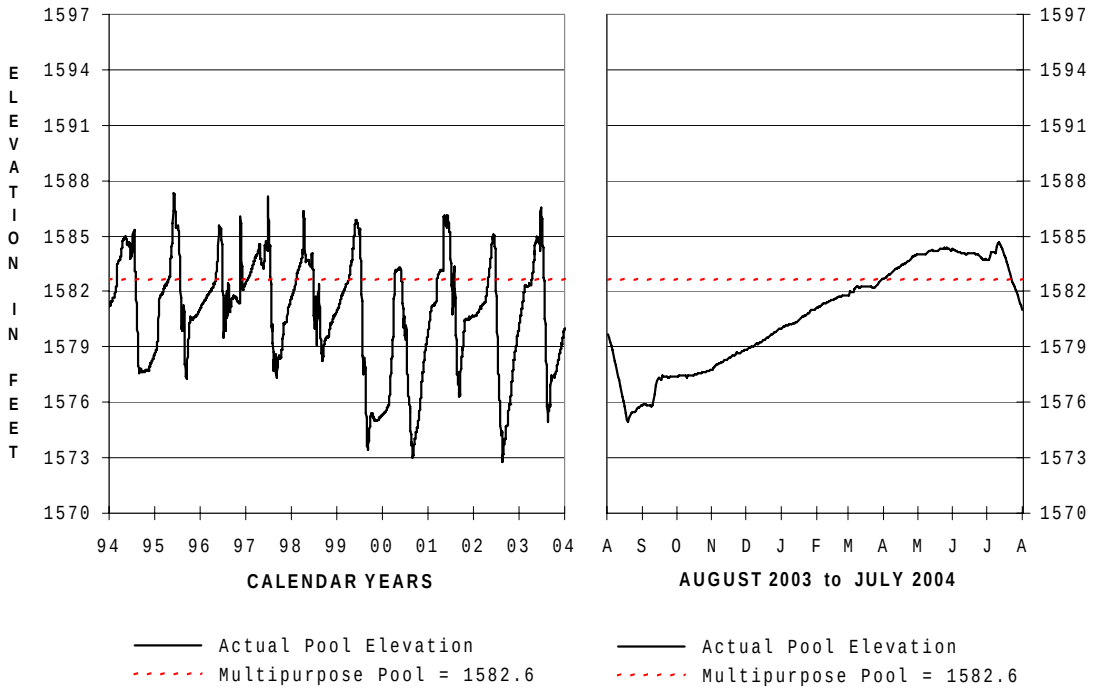
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1711.63 1 Aug 03	**1706.62 31 Jul 04**	**1711.63 1 Aug 03**	**1706.62 31 Jul 04**	**1737.07 2 Jun 95**	**1695.45 11 Feb 81**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
120 11 Sep 03	**4,720**	**0 All days**	**0 All days**

Maximum daily outflow is river release only.

LOVEWELL RESERVOIR
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



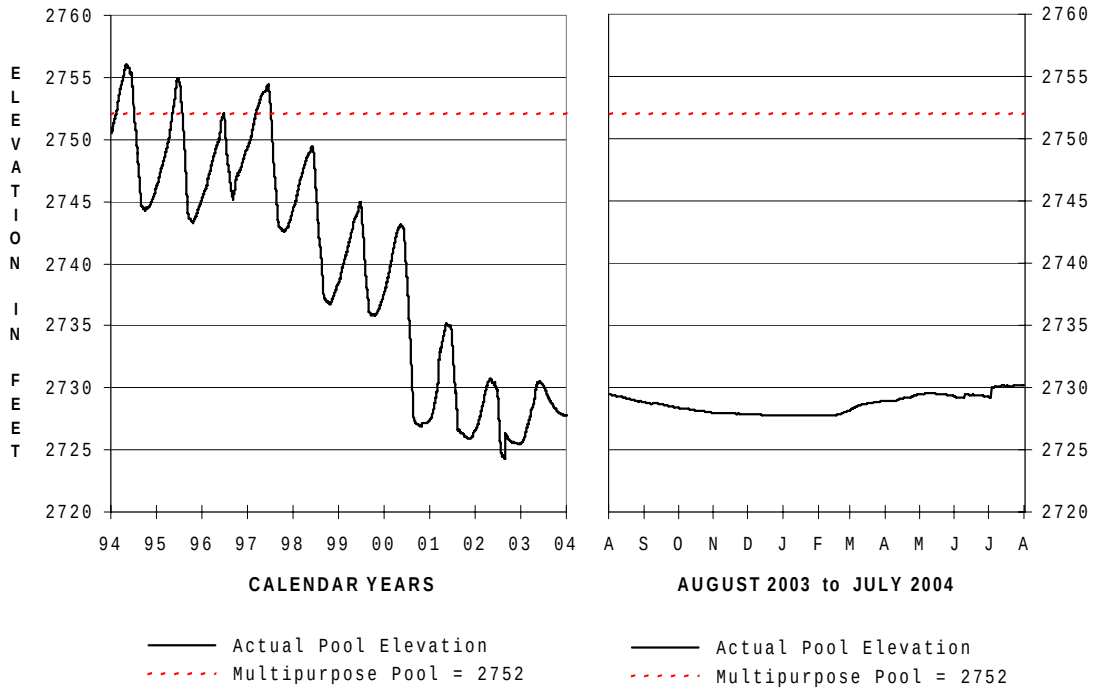
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1579.68 1 Aug 03	**1581.02 31 Jul 04**	**1584.67 10 Jul 04**	**1574.95 19 Aug 03**	**1595.34 22 Jul 93**	**1570.20 22 Aug 91**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
850 9 Jul 04	**19,110**	**200 10 Jul 04**	**0 Most days**

Maximum daily outflow is river release only. No required min release.

SWANSON LAKE
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



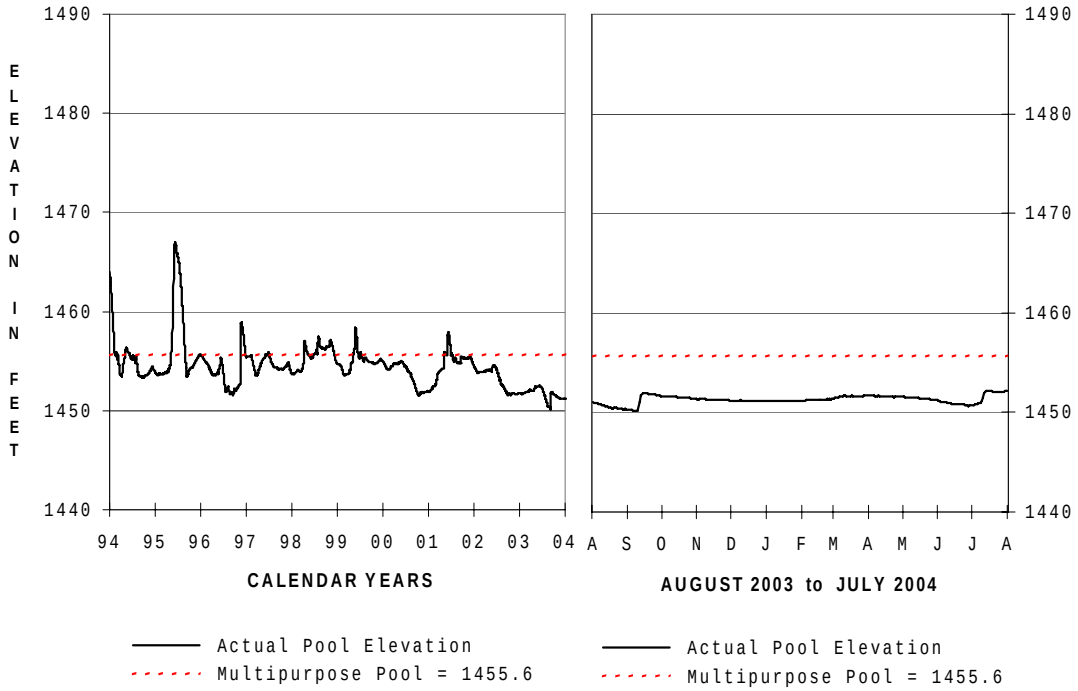
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2729.46 1 Aug 03	**2730.16 31 Jul 04**	**2730.20 26 Jul 04**	**2727.76 2 Jan 04**	**2757.40 3-4 Aug 62**	**2724.3 26 Aug 02**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
470 2 Jul 04	**11,150**	**1 All days**	**1 All days**

Max daily outflow is river release only.

WACONDA LAKE
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



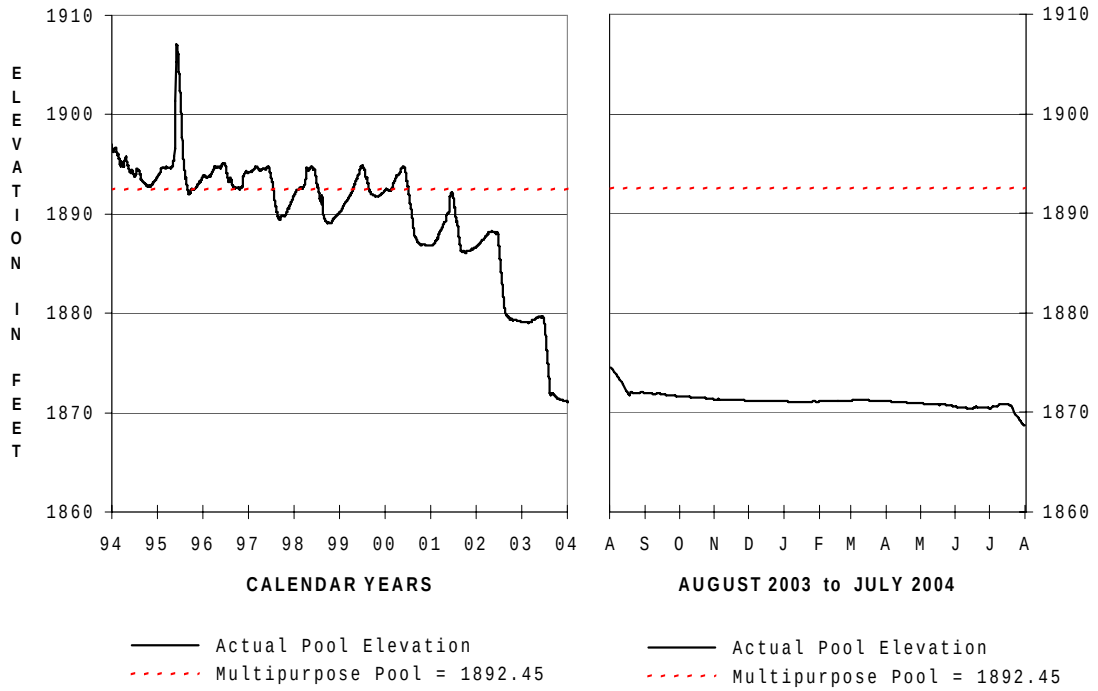
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1451.05 1 Aug 03	**1452.19 31 Jul 04**	**1452.19 31 Jul 04**	**1450.13 10 Sep 03**	**1487.02 29 Jul 93**	**1448.90 6-7 Dec 84**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
4000 11 Sep 03	**76,190**	**120 3 Aug 03**	**18 Most days**

The max daily outflow is river release only.

WEBSTER RESERVOIR
2003 - 2004 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1874.55 1 Aug 03	**1868.67 31 Jul 04**	**1874.55 1 Aug 03**	**1868.67 31 Jul 04**	**1907.04 5 Jun 95**	**1857.35 22-29 Oct 71**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
240 19 Aug 03	**4,500**	**200 21 Jul 04**	**0 Most days**

All releases to river. Max daily outflow occurred as part of normal irrigation releases. No required minimum release.